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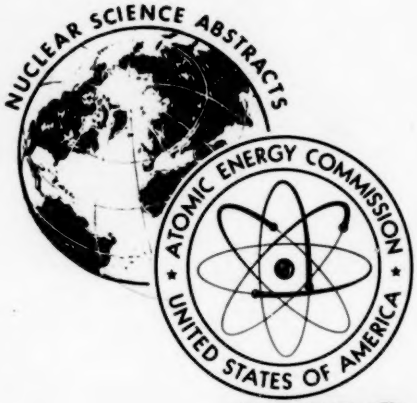

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Volume 18, Number 23, December 15, 1964

NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

Refer also to abstract 42162.

41009 (EUR-1850.e(p.83-98)) EURATOM AND RADIOBIOLOGY. F. Van Hoeck, A. Bertinchamps, and R. K. Appleyard (European Atomic Energy Community).

A review of the radiobiology program in EURATOM is presented. This program was initiated to study radiation effects and associated human hazards, and the uses of nuclear techniques in industry and medicine. The research is conducted mostly by laboratories and institutes under contract. (J.R.D.)

41010 (HW-80500) HANFORD BIOLOGY RESEARCH ANNUAL REPORT FOR 1963. H. A. Kornberg and E. G. Sweza, eds. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 15, 1964. Contract AT(45-1)-1350. 259p.

Separate abstracts were prepared for 51 sections of this report. Four sections were previously abstracted and appeared in NSA Vol. 18 as numbers 8084, 8085, 8089, and 8162. A list is included of publications during the period covered by this report. (C.H.)

For abstracts of individual papers see: 41011, 41012, 41015, 41016, 41017, 41018, 41019, 41022, 41023, 41024, 41025, 41026, 41027, 41028, 41029, 41030, 41031, 41032, 41033, 41034, 41035, 41036, 41037, 41038, 41039, 41040, 41041, 41042, 41043, 41044, 41075, 41076, 41077, 41078, 41079, 41080, 41081, 41082, 41083, 41084, 41085, 41086, 41087, 41088, 41241, 41242, 41257, 41274, 41275, 41645, and 41646.

41011 (HW-80500(p.129-31)) CYTOTOXIC ANTIBODY ANALYSIS BY ELECTRONIC CELL COUNTING. E. M. Uyeki (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

In radiation chimeras, analysis for the presence of host or donor cells other than erythrocytes is difficult due to the lack of available testing methods. A method is described in which trypsin is used to digest lymph node cells injured by the action of cytotoxic antibody and complement. The Coulter electronic particle counter was used to count the unaltered cells after tryptic digestion of lymph nodes from mouse chimeras. (auth)

41012 (HW-80500(p.195-202)) INCIDENCE AND VIRULENCE OF COLUMNARIS. [PART] III. M. P. Fujihara, P. A. Olson, and R. E. Nakatani (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Incidence of Chondrococcus columnaris on fish taken from the Yakima River was much earlier and greater than from fish taken from slough areas of the Columbia River within the Hanford Reservation. The presence of general skin lesions or necrotic gill areas is not a reliable indication of columnaris infection. Trough studies showed high temperatures and crowding increased mortalities from both columnaris and other causes. The pattern of death and recovery from infection suggests an immunity response. To date there does not appear to be a correlation between the presence of high virulence forms and high death rate. (auth)

41013 ANTIGEN PRETREATMENT AND MECHANISMS OF THE RESULTING TEMPORARY TOLERANCE. Nicholas A. Halasz and Marshall J. Orloff (Harbor General Hospital, Torrance, Calif. and Univ. of California, Los Angeles). Proc. Soc. Exptl. Biol. Med., 116: 987-90(Aug.-Sept. 1964).

Three factors were studied in animals showing prolonged homograft survival as a result of donor antigen pretreatment. The possible contribution of a graft-vs-host reaction to prolonged homograft survival, wasting, or lymphoid depletion was eliminated by using irradiated donor blood for conditioning, and irradiated transplants, and finding no significant change in homograft survival or in degree of lymphoid depletion. Any role the thymus may play as a source of lymphoid repopulation when conditioned animals reject homografts was ruled out by finding no increase in homograft survival in animals conditioned and transplanted after thymectomy. The importance of primary vascular contact between conditioned recipient and transplant was shown by the absence of wasting and lymphoid depletion on conditioned animals which receive massive skin homografts, rather than kidney transplants. (auth)

41014 GRUNDLAGEN DER NUKLEARMEDIZIN FÜR TIERÄRZTE. (Fundamentals of Nuclear Medicine for Veterinarians). Guenter Mehlhorn. Jena, Ger., VEB Gustav Fischer Verlag, 1964. 256p. DM 37.50.

The fundamentals of nuclear medicine as applicable to veterinary medicine are reviewed. The characteristics of nuclear weapons that cause damage to animals, the sources of radiation, effects of radiation, pressure, and heat on animals, and the contamination of food of animal origin, feeds, and drinking water are the subjects considered. In a supplement, the nuclear physics basic concepts, radiation measurement units, and measurement methods and devices are reviewed. (J.S.R.)

Ecology

41015 (HW-80500(p.203-4)) CHINOOK SALMON SPAWNING NEAR HANFORD, 1963. D. G. Watson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The approximate 1300 chinook salmon nests observed in the Columbia River near Hanford were the second highest in 17 years. Trends in numbers of local salmon spawners generally follow that of the salmon runs in the river prior to 1960; thereafter, the increase in numbers of Hanford salmon is greater than the runs in the river. (auth)

41016 (HW-80500(p.205-8)) SWIMMING PERFORMANCE OF CHINOOK SALMON REARED IN REACTOR EFFLUENT. [PART] II. R. E. Nakatani (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Swimming performance of chinook salmon at three different water velocities after being reared for 17 weeks in 3 and 6% reactor effluent with a corrosion inhibitor additive of either sodium dichromate or INHIB-7 showed no difference due to effluent concentration or type of additive. The size of fish (51 to 55 mm and 56 to 60 mm) tested emphasized the importance of size by the obviously better performance of the longer fish. The question is raised of whether within a particular size stratum the runts are poorer swimmers than fish representing the average size of a lot. (auth)

41017 (HW-80500(p.212-18)) PLANKTON-WATER CHEMISTRY CYCLES IN THE COLUMBIA RIVER. C. E. Cushing (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Progress is reported in a detailed study of the seasonal cycles of the dominant phytoplankters, chemical constituents, and certain physical factors at three locations on the Columbia River. Asterionella, the dominant diatom enumerated, exhibited two seasonal increases; whereas the other genera each had single pulses. The spring pulse of diatoms coincided with an increased volume of water, a decrease of nitrate and phosphate, an increase in dissolved silica, and an increase in water temperature and effective light penetration. The data indicate that nutrients were not limiting and that the probable causal factors for population increases were the increasing water temperatures and effective light. The summer decrease of several nutrients suggests nutrient assimilation by the algae rather than dilution by runoff. (auth)

41018 (HW-80500(p.219-22)) VEGETATIONAL ANALYSIS IN A SAGEBRUSH STAND. L. L. Eberhardt and W. H. Rickard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A multiple-stage, random sampling method was devised to estimate weights of non-woody vegetation in a sagebrush stand. Grasses and forbs constituted about 20% of total non-woody vegetation, while sagebrush leaves accounted for the balance, giving a total of 58 g/m^2. (auth)

41019 (HW-80500(p.223-5)) SOME THEORETICAL CONSIDERATIONS IN "DISTANCE" SAMPLING. L. L. Eberhardt (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (HW-SA-3367)

The recent ecological literature contains increasingly frequent references to measurements between individual plants or animals ("nearest neighbor"), or from sampling points to the nearest (or nth nearest) individual. Various theoretical results have been derived for what might be termed the "Poisson" case, that is, for some infinitely large region over which individuals are randomly located. In this particular circumstance, theoretical results apply equally well to measurements between individuals or between a randomly located and the nearest (or nth nearest) individual. When, as is most often the case, individuals are not randomly distributed, it seems theoretically advantageous to make all measurements from randomly selected points, thus insuring statistical independence. Results are reported for distances measured from randomly located sampling points. Some results are reported that are applicable to particular cases of non-random distribution of plants or animals. The results should be useful in evaluating investigations where distance measurements have been used for estimating densities, and in studying various proposals for indices to non-randomness, association, segregation, etc., based on distance measurements. (auth)

41020 UPTAKE AND INCORPORATION OF RADIOACTIVE SULFATE AND PHOSPHATE DURING GROWTH OF RICE PLANTS. Julia Szepes (Institut für Pflanzenphysiologie, Budapest). Naturwissenschaften, 51: 393 (1964). (In German)

Rice leaves in various development stages were placed in solutions of Na_2SO_4 or Na_2HPO_4 with activity of 0.5 mC (^{35}S or ^{32}P) and later fractionated with the help of 10% trichloroacetic acid. The fractions soluble in trichloroactive acid in all three stages contained almost exactly the same percent of ^{32}P or ^{35}S. In the insoluble fraction the uptake of ^{32}P was greater than ^{35}S. Fresh shoots showed higher uptake than either buds or fully grown plants for ^{35}S, but for ^{32}P fully grown plants showed the most uptake with shoots the least. (M.C.G.)

Metabolism, Tissue Distribution, and Toxicology

41021 (BNL-857) THE IMPACT OF ISOTOPIC TRACERS ON PHYSIOLOGICAL CONCEPTS. James S. Robertson (Brookhaven National Lab., Upton, N. Y.). Feb. 12, 1964. Contract AT-30-2-GEN-16. 15p.

Brookhaven Lecture Series No. 33.

Applications of radioisotopes as tracers in studies of pathways of metabolized substances in the body and the kinetics of steady state systems are reviewed. It is pointed out that tracer studies have shown that most of the body tissues are subject to constant renewal. Applications of pulse-height analyzers, whole-body counters, and computers in obtaining and evaluating data from clinical tracer studies in man are discussed. 42 references. (C.H.)

41022 (HW-80500(p.1-5)) BIOLOGICAL EFFECTS OF I^{131} IN SHEEP. H. A. Ragan, V. G. Horstman, W. J. Clarke, R. O. McClellan, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Ewes fed a single 3 mc dose of ^{131}I five to six years ago causing chronic hypothyroidism showed little change in the estrus cycle, conception rate, or gestation period. Lambs from the hypothyroid ewes exhibited a lower mean serum protein-bound iodine (PBI) than lambs from control ewes and slower growth, probably due to the low milk production of their dams. Six thyroid adenomas and four pituitary adenomas occurred in seven animals that died in this group. Thyroid adenomas also developed in two ewes fed 1.5 or 5 μc ^{131}I/day for five or more years. (auth)

41023 (HW-80500(p.19-23)) EFFECT OF STABLE IODINE ON I^{131} CONCENTRATION IN THYROID AND MILK OF DAIRY CATTLE. D. H. Wood, H. A. Ragan, R. O. McClellan, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Each of three cows were fed 5 μc ^{131}I and various levels of ^{127}I daily. Thyroid ^{131}I burdens stabilized at $1\frac{1}{2}$ to 2 times the daily dose after two weeks. Thyroid concentrations of ^{131}I were influenced by stable iodine supplements as low as 15 mg/day, while 2 g ^{127}I/day was necessary to cause milk ^{131}I concentrations to drop significantly. Mammary gland concentrations of ^{131}I were about the same as plasma concentrations. (auth)

41024 (HW-80500(p.24-9)) APPLICATION OF MINIATURE GOATS IN RADIOIODINE STUDIES. H. A. Ragan, V. G. Horstman, Glenda S. Vogt, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Some anatomical and physiological characteristics of African miniature goats were determined and compared with those described for larger ruminants. Adult females, fed ^{131}I daily prior to parturition and until the offspring were three and one-half months of age, reached thyroid equilibrium in eight days at four to five times the daily dose. Blood ^{131}I and milk ^{131}I ratios were more similar to those described for cattle than for standard goats. Thyroid ^{131}I in the newborn approximated the dam's daily intake, reached a plateau at $\sim 75\%$ of this value a few days following birth, and fell to $< 7\%$ by 60 days of age. (auth)

41025 (HW-80500(p.50-1)) PRELIMINARY STUDIES OF INHALED URANIUM ORE. B. O. Stuart, R. W. Perkins, and T. M. Beasley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Preliminary studies of inhaled uranium ore dust in rats indicate that daughter radionuclides deposited in the lungs do not remain in secular equilibrium. Thorium-230 to ^{238}U ratios increased from 1.0 to more than 2 or 3 within eight weeks after exposure. (auth)

41026 (HW-80500(p.52-8)) TOXICITY OF INHALED CERIUM DIOXIDE. B. O. Stuart and H. W. Casey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Inhaled $^{144}Ce-^{144}PrO_2$ was retained in beagle dogs with biological half-lives of 1.5 to 5 years. An initial deposition of 2 mc in one animal caused death at eight months postexposure, showing extensive damage to the lungs, bronchial lymph nodes, heart, and the entire reticulo-endothelial system. Leukocyte levels in all animals decreased soon after exposure, and tended to remain below controls. (auth)

41027 (HW-80500(p.59-63)) PRELIMINARY STUDIES OF INHALED Pm^{147} PERCHLORATE. B. O. Stuart (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Beagle dogs were exposed to ^{147}Pm perchlorate by inhalation or intravenous injection. Retention of a few millicuries caused severe damage to several critical organs in one to two months. Concentrations of ^{147}Pm in liver and bone tissue after both routes of administration were high. Rapidly decreasing rates of ^{147}Pm excretion and calculated whole-body retention curves suggested a long biological half-life. (auth)

41028 (HW-80500(p.67-9)) TOXICITY OF Pu^{239} AND Pu^{238} IN THE RAT. J. E. Ballou, W. J. Clarke, J. L. Palotay, and Glenda S. Vogt (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Comparison of the histopathological and hematological changes preceding death from equal microcurie doses of ^{238}Pu and ^{239}Pu indicates damage to spleen may contribute to the earlier death with ^{239}Pu. Death from ^{238}Pu was preceded by a decrease in marrow capacity due to the marked increase in trabecular bone in the marrow spaces. Peripheral blood values did not reflect the progressive decrease in marrow volume. (auth)

41029 (HW-80500(p.70-2)) ADRENAL DISTRIBUTION OF Np^{237} AND Pu^{239}. J. E. Ballou (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Plutonium-239 and ^{237}Np deposited in the outer cortex of the adrenal gland of rats appear to be uniformly spread throughout the cells of the zona glomerulosa. Within the zona reticularis, deposition is primarily in cells of the reticulo-endothelial system. Plutonium does not appear to be associated with the extractable lipid fraction or with cell nuclei. The fraction of Pu deposited in the adrenal is markedly influenced by the mass of radionuclide injected. (auth)

41030 (HW-80500(p.73-5)) INTERACTIONS IN THE METABOLISM OF Pu^{239} AND Np^{239}. V. H. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Deposition of ^{239}Np in the liver of rats is very significantly increased by the simultaneous administration of ^{239}Pu. It is postulated that ^{239}Pu, because of its relatively much greater mass, tends to carry the ^{239}Np. DTPA is considerably less effective in removing ^{239}Np from the liver than in removing ^{239}Pu from the liver; and is totally ineffective in removing ^{239}Np from femurs. (auth)

41031 (HW-80500(p.76-8)) Np^{237} AND LIVER LIPID METABOLISM. D. D. Mahlum (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Rats treated with ^{237}Np incorporated about twice as much 1-^{14}C-acetate into liver lipids as did control animals, suggesting either an increased synthesis or a decreased secretion of fat by the liver. In addition, the oxidation of 1-^{14}C-palmitic acid to CO_2 by the rat was decreased by ^{237}Np administration. (auth)

41032 (HW-80500(p.79-82)) NEPHROTOXICITY OF Ra^{226}. R. O. McClellan, W. J. Clarke, J. L. Palotay, and Glenda S. Vogt (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Six female miniature swine three or more years old when injected intravenously with 6.4 μc ^{226}Ra/kg developed a severe nephritis and died. One of four females injected at one year of age developed a similar lesion and died. No evidence of kidney damage was seen in any of nine male animals, injected when one year old or less, either in those killed at 18 months post-injection or in those still alive three years after injection. (auth)

41033 (HW-80500(p.83-99)) BIOLOGICAL EFFECTS OF Sr^{90} IN MINIATURE SWINE. FOURTH PROGRESS REPORT. R. O. McClellan, W. J. Clarke, Glenda S. Vogt, H. A. Ragan, J. L. Palotay, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Biological effects were observed in miniature swine fed from 1 to 3100 μc ^{90}Sr daily. Approximately 240 animals are being maintained for lifetime observation. Three generations of animals fed 1, 5, or 25 μc ^{90}Sr/day for up to 56 months have shown no definite effects. Animals fed 125 μc ^{90}Sr/day for over three years appear to be in good condition, but manifest a neutropenia, lymphopenia, and thrombocytopenia. Offspring of animals fed 625 μc ^{90}Sr/day showed progressive hematological changes with about one-half of the offspring dying at three months of age. In eight of the offspring that died, there was myeloid and reticulum cell infiltration of several organs including the kidney, heart, testes, and lung. The ^{90}Sr body burden of animals exposed throughout life increased until about two years of age when it was approximately 10 times the daily intake. The body burden of animals started on ^{90}Sr feeding at nine months of age increased with time, but after a year of daily ^{90}Sr feeding still was less than comparable aged animals exposed since conception. The skeleton of animals exposed to ^{90}Sr since conception was uniformly labeled with ^{90}Sr relative to Ca or total ash. The skeletons of animals started on ^{90}Sr as young adults were not uniformly labeled with ^{90}Sr. The radiation dose rate varied accordingly in these animals. (auth)

41034 (HW-80500(p.100-1)) GASTROINTESTINAL ABSORPTION OF Sr^{85} TITANATE. R. O. McClellan and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Ten days after ingestion of ^{85}SrTiO$_3$, miniature swine retained less than 0.3% of the administered dose in their skeleton. (auth)

41035 (HW-80500(p.102-8)) TRANSFER TO MILK AND ERYTHROCYTE UPTAKE OF K^{42}, Rb^{86} AND Cs^{137}. R. O. McClellan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Transfer of ^{42}K, ^{86}Rb, and ^{137}Cs from plasma to milk and from plasma to erythrocytes following a single intravenous dose was measured in mature sheep. The plasma-to-milk ratios were: ^{42}K, 8 to 12; ^{86}Rb, 12 to 18; and ^{137}Cs, 12 to 20. All three radionuclides were concentrated in erythrocytes and had similar patterns of erythrocyte uptake in a given individual, although marked differences were evident between individuals. (auth)

41036 (HW-80500(p.109-12)) DISTRIBUTION AND RETENTION OF Zn^{65} IN TROUT. R. E. Nakatani and D. H. W. Liu (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Trout fed a single oral dose of 200 μc ^{65}Zn were killed serially from 8 to 182 days post-administration to study distribution and retention. The decrease in body burden of 25 μc ^{65}Zn at day 8 to about 10 μc ^{65}Zn at day 182 is described by $Y = 1.41 - 0.0021\ X$, where Y is the log μc ^{65}Zn and X is the time in days post-administration. The relatively high activity found in the gastrointestinal tract comprised over 50% of the body burden from day 85 to day 182. Further observations will continue to cover about a year. (auth)

41037 (HW-80500(p.116-19)) EXCRETION OF Pu^{239} INTO THE INTESTINE. J. E. Ballou and M. F. Sullivan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Studies with gut-perfused and bile duct-cannulated rats implicate the bile as a major route of plutonium-239 excretion into the intestine. Plutonium collected from the cannulated bile duct accounted for about half of the intestinally excreted radionuclide immediately after injection and accounted for 75 to 90%, subsequent to DTPA administration. Biliary plutonium levels increased 12-fold subsequent to DTPA treatment and remained higher than pretreatment levels for at least four days. (auth)

41038 (HW-80500(p.134-7)) SYNTHESIS OF LONG-CHAIN FATTY ACIDS BY RAT LUNG TISSUE. E. C. Tombropoulos (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Alveolar stability depends on the presence of physiological surfactants. The pulmonary surfactant material consists mainly of lipids, of which approximately 75% is phospholipid. There are indications that the activity of pulmonary surfactants may be inhibited by accumulation of excess free lipids. Preliminary results are reported from studies on lipid metabolism of lung tissue, specifically acetate-1-^{14}C incorporation into fatty acids in rats. These studies are the beginning of a project to determine the effect of radioactive particles on lung metabolism, especially lipid metabolism. (auth)

41039 (HW-80500(p.140-3)) ZINC–CADMIUM INTERRELATIONSHIPS. Beatrice J. McClanahan and H. A. Kornberg (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

In vitro studies on sheep erythrocytes using the element pair, Zn and Cd, and metabolic toxins indicated that no metabolic process is involved in the transfer of ^{65}Zn into erythrocytes. In preliminary studies on the transfer of ^{65}Zn and ^{115m}Cd from plasma to milk in sheep, milk-to-plasma ratios of 2 to 4 for ^{65}Zn and 10 to 20 for ^{115m}Cd were obtained. An interaction between Zn and Cd in rats was shown in liver, pancreas, serum, and small intestine. (auth)

41040 (HW-80500(p.181-4)) ACCUMULATION OF IODIDE BY INTACT BARLEY PLANTS. R. L. Uhler (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The accumulation of iodide by barley plants is a linear function of time and exponentially related to substrate concentration. It is independent of transpiration and photoperiod, and is sensitive to chloramphenicol inhibition. Evidence for the active transport of iodide is inconclusive. (auth)

41041 (HW-80500(p.185-6)) CESIUM TOXICITY IN PLANTS. J. F. Cline (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Roots of pea seedlings were exposed to nutrient solutions containing Cs. Chromatin of the meristematic cells was greatly reduced at the highest Cs concentration, but at the lower concentrations mitotic indices were variously affected. (auth)

41042 (HW-80500(p.187-90)) REMOVAL OF Pu^{239}, W^{185}, AND Pb^{210} FROM SOIL BY PLANTS AND ION EXTRACTION SOLUTIONS. D. O. Wilson and J. F. Cline (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The uptake of ^{210}Pb, ^{185}W, and ^{239}Pu by plants and the interaction of these elements with soil and chelating agents were studied. The uptake of ^{210}Pb by barley was studied using a modified Neubauer technique. The uptake of ^{185}W and ^{239}Pu was studied by growing beans and barley in metal cans containing 1600 g of soil. The isotopes were added to the soil as K$_2$WO$_4$, PbCl$_2$, and Pu(NO$_3$)$_4$. In all uptake studies, the level of isotope in the soil was calculated to give 0.1 μc/g of dry soil at the time of harvest. Two soil types, Cinebar and Ephrata, were used in the ^{210}Pb studies and these, combined with a third soil type, Millville, comprised the soil types used in the ^{185}W and ^{239}Pu studies. All vegetation weights are reported on a dry-weight basis. L/S ratios ranged from $<$ 0.000015 to 0.00026 for ^{239}Pu, from 0.002 to 0.005 for ^{210}Pb, and from 0.009 to 0.28 for ^{185}W. All extracting agents removed greater quantities of ^{239}Pu and ^{185}W than did plants. A 200 : 1 molar excess of DTPA caused 28% of the ^{239}Pu to remain in the equilibrium solution of the Cinebar soil. (auth)

41043 (HW-80500(p.209-11)) TOXICITY OF INDUSTRIAL CHEMICALS TO FISH. D. H. W. Liu and R. E. Nakatani (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The toxicity of nine chemical agents was evaluated to obtain estimates of critical concentrations safe for fish of commercial value in the Columbia River. Estimates of TL$_m$ and threshold indices were calculated graphically and a 0.1 safety factor applied to the latter to obtain the safe river concentration. (auth)

41044 (HW-80500(p.226-9)) POTASSIUM AND SODIUM CYCLING BY GREASEWOOD AND HOPSAGE. W. H. Rickard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Mineral analyses of greasewood (*Sarcobatus vermiculatus*) and hopsage (*Grayia spinosa*) leaves harvested from leaf-out until leaf-fall in 1963 showed that greasewood leaves accumulated sodium while hopsage leaves accumulated like amounts of potassium. The mineral uptake of the shrubs altered soil chemistry beneath their canopies in a manner consistent with their uptake behavior. (auth)

41045 (NP-14327) LANGFRISTIGE FUTTERUNGSVERSUCHE MIT ^{90}Sr CONTAMINIERTER NAHRUNG. (Prolonged Feeding Experiments with ^{90}Sr Contaminated Food (thesis)). Manfred Fingerhut (Johannes-Gutenberg-Universität, Mainz). 1963. 187p.

In experiments on Sprague Dawley rats the effects and retention of low doses of ^{90}Sr over five generations were followed. The ^{90}Sr was given by mouth in two concentrations (140 and 350 pC ^{90}Sr/g Ca) in the feed. The regularities of Ca and ^{90}Sr retention as well as equilibrium adjustments in the skeleton are described. The increase of strontium units in the skeleton as well as the contamination in pC ^{90}Sr per animal in the first generation took place exponentially. In the next generation the strontium units in the skeleton were almost double those in the first generation. In the following generations, however, there was no further increase in this value ascertained. The course of the strontium units in the skeleton and the contamination in pC ^{90}Sr per animal in the second and following generations can be described by exponential functions. In discrimination capacity against ^{90}Sr no distinction between the sexes was established, nevertheless it was age dependent. No noteworthy differences between the control group and the test groups were established for the following: growth, protein efficiency, organ weight, fertility, rearing capacity for young, lifetime, and results of histological investigations of the organs and blood. Studies of bone marrow also showed no difference from the controls. In comparisons of liver function, the test groups showed a significant retention increase, which was dependent on the amount of ^{90}Sr in the feed and on age and independent of generation. From the skeletal contamination the radiation dose was estimated. Comparison of animal experiments with the conditions for man is discussed. Data are presented in tables and graphs. (tr-auth)

41046 (NP-14333) ZUR BEEINFLUSSUNG DES ^{90}Sr-STOFFWECHSELS BEI DER WACHSENDEN RATTE DURCH VITAMIN D_3 UND A_1. (Effects of Vitamin D_3 and A_1 on ^{90}Sr Metabolism in the Growing Rat. (Thesis)). Berthold Schmidt (Johannes-Gutenberg-Universität, Mainz). 1963. 135p.

The influence of continually given vitamins on the metabolism of ^{90}Sr taken daily by growing rats was investigated. Emphasis was placed on vitamins A and D. Food assimilation succumbed to a plain vitamin D influence, as was shown by the desire for food. In administration of vitamin A no such effect was observed. Growth was accelerated by doses of vitamins D and A. Over-dosing led to growth retardation and standstill. The reabsorption of Ca and ^{90}Sr was strongly influenced by both vitamin A and vitamin D as was perceptible in excretion in the feces. With increasing vitamin D the reabsorption of Ca was rapidly increased, for ^{90}Sr the same effect, if not so distinct, was observed. Small and medium doses of vitamin A showed a similar effect on the reabsorption improvement of Ca and ^{90}Sr, but at high doses an almost complete decrease in assimilation of Ca and ^{90}Sr was observed. The formation and calcification of the skeleton was improved by massive doses of vitamin D. Increased doses led to disturbance of the skeletal mineralization produced by a useless deposition of inorganic material in the organic bone marrow. For increased supplies of vitamin A the ratio of organic to inorganic marrow material was not disturbed so much as the building of the skeleton in general. Only at very high vitamin doses were effects on the incorporation of Ca and ^{90}Sr in the skeleton observed. With increasing vitamin D the renal elimination of Ca and ^{90}Sr increased. Vitamin A had a direct initial point for blood clearance of the kidneys. Ca and ^{90}Sr elimination decreased with increasing vitamin A dose. Data are presented in tables and graphs. (M.C.G.)

41047 (HW-tr-79) URINARY EXCRETION OF STABLE IODINE. F. Casson, P. Carenza, R. Guido, and W. Petrilli. Translated by E. R. Appleby (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.), from Acta Isotopica, 2: 391-400(1963). 14p.

The contents of stable inorganic iodine and ^{131}I 24 hr after the administration of doses varying from 50 to 100 μc were determined in plasma and urine of euthyroid, hyperthyroid, and hypothyroid patients and in patients with normometabolic goiter. Data are included on thyroid fixation and urinary excretion of I in the same patients. Data are included on the urinary excretion of ^{127}I by normal subjects. (C.H.)

41048 AUTORADIOGRAPHY WITH ISOTOPES EMITTING INTERNAL CONVERSION ELECTRONS AND AUGER ELECTRONS. S. Forberg, E. Odeblad, R. Soeremark, and S. Ullberg (Royal Inst. of Tech., Stockholm; Karolinska Institutet, Stockholm; Royal Veterinary Coll., Stockholm; and Harvard Univ., Boston). Acta Radiol., Therapy, Phys., Biol. (N.S.), 2: 241-62(Aug. 1964).

Several radioactive nuclides emitting internal conversion and Auger electrons were found to be of practical value in medical autoradiography. The physical background for using these types of extranuclear electron radiation is discussed. Iron-55, ^{85}Sr, ^{109}Cd, and ^{125}I proved to offer very good resolution. Autoradiographic techniques favoring a registration of the low energy internal conversion and Auger electrons emitted from these and other nuclides are discussed. (auth)

41049 THE UPTAKE OF RADIOACTIVE RUTHENIUM BY RAT LIVER NUCLEI. I. G. F. Gilbert and J. M. Radley (Royal Cancer Hospital, London). Biochim. Biophys. Acta, 79: 568-74(May 25, 1964).

The transfer of ruthenium between cytoplasm and nucleus in liver cells was studied following the administration of ^{106}Ru to rats, using the Lissapol nuclear isolation procedure. During the experimental period the isotope is lost from the cytoplasm approximately exponentially with a half-time of 100 hr but is taken up by the nuclei at a rate corresponding to a half-time of about 45 hr; after 100 to 200 hr there is a constant partition of the isotope between nucleus and cytoplasm. Mechanisms are considered which may account for the experimental results and it is tentatively concluded that the nuclear membrane has a restricted permeability to Ru in the chemical form in which it occurs in the cytoplasm, perhaps as a high molecular weight complex. The results accord with a permeability coefficient of the nuclear membrane to Ru of about 10^{-9} cm sec^{-1}, which is similar for both inward and outward movement, suggesting that the permeation is passive and non-specific. (auth)

41050 EFFECTS OF PARTIAL DEUTERATION ON TRANSFORMING DNA OF PNEUMOCOCCUS. Claudine Martin and Harriett Ephrussi-Taylor (CNRS, [Paris] and Western Reserve Univ., Cleveland). Biochim. Biophys. Acta, 80: 411-21(Mar. 23, 1964).

When Diplococcus pneumoniae is grown in a medium prepared by dissolving complex nutrients in ^2H_2O, DNA molecules bearing different genetic markers, and representing different segments of the genome, show the same degree of partial deuteration. However, considerable heterogeneity in the degree of deuteration of the DNA is revealed by the fact that the most heavily deuterated molecules are peculiarly subject to spontaneous degradation, leading to biological inactivation. After several months of storage of partially purified DNA preparations, the residual biological activity is found to be associated with the least deuterated DNA molecules. Partially deuterated DNA is not, therefore, a suitable material for experiments designed to study the fate of incorporated DNA in transformation. (auth)

41051 A PROCEDURE FOR THE ISOLATION OF CELL NUCLEI FOR TRACE-METAL STUDIES. I. G. F. Gilbert and J. M. Radley (Royal Cancer Hospital, London). Biochim. Biophys. Acta, 82: 618-21(Mar. 16, 1964).

A technique is described for isolating cell nuclei for use in trace metal studies. The extent to which metals may be eluted from nuclei during isolation was investigated using ^{65}Zn, ^{54}Mn, ^{51}Cr, and ^{106}Ru as tracers in preparations of rat liver nuclei. (C.H.)

41052 PARALLEL LABELLING OF NON-DIALYZABLE COMPONENTS OF RABBIT URINE FOLLOWING $^{75}SeO_4$ AND $^{35}SO_4$ INJECTION. John T. Galambos and Irving Green (Emory Univ., Atlanta). Biochim. Biophys. Acta, 83: 204-8(July 7, 1964).

Following the intravenous administration of $Na_2^{75}SeO_4$ and $Na_2^{35}SO_4$ in rabbits, the nondialyzable solids of urine were labelled with ^{35}S and ^{75}Se in a parallel manner both on $BaCO_3$-fractionated specimens and when chondroitin sulfate A and C were isolated by glass-paper chromatography. ^{75}Se-labelled selenate may be a useful adjunct to the tools currently available for the metabolic studies of sulfomucopolysaccharides. (auth)

41053 ISOTOPE AND SOLVENT EFFECTS OF DEUTERIUM ON RABBIT-MUSCLE LACTATE DEHYDROGENASE. John F. Thomson, Jacqueline J. Darling, and Linda F. Bordner (Argonne National Lab., Ill.). Biochim. Biophys. Acta, 85: 177-85(May 4, 1964).

Samples of $NADH_2$ containing deuterium in different positions were compared with the protium compound as coenzymes for rabbit-muscle lactate dehydrogenase (L-lactate: NAD oxidoreductase, EC 1.1.1.27). Assays were carried out in both H_2O and ^2H_2O. In both solvents there was a normal isotope effect (1.3 – 1.4) on the maximum velocity when deuterium was substituted for the transferable hydrogen [α-4-^{2}H]NAD, but the effect of secondary substitution [β-4-^{2}H]NAD was inverse (0.7 – 0.8). In H_2O, [α-4-^{2}H]NAD was bound more rapidly and more firmly to the enzyme than was $NADH_2$, whereas [β-4-^{2}H]NAD was less so. In ^2H_2O, the relative rates of binding were reversed, [β-4-^{2}H]NAD being bound most rapidly; however, the dissociation constants of the enzyme–coenzyme complex were altered the same way in both solvents. (auth)

41054 ACCUMULATION OF MICROQUANTITIES OF STRONTIUM BY GREEN AND BLUE-GREEN ALGAE. A. L. Agre and A. P. Raiko (Panfilov Academy of Communal Economy, Moscow). Fiziol. Rast., 11: No. 1, 135-7(1964). (In Russian)

The uptake of ^{90}Sr was studied using eleven different types of algae in flasks of ^{90}Sr solutions taken from the main Moscow water supply (Moscow tap water contains 0.05 to 0.005 mg/l of stable strontium). The results showed that the coefficients of ^{90}Sr accumulation by green and blue-green algae are not constant and vary with the concentration in the solution. (R.V.J.)

41055 IMPROVEMENT OF A HIGH-RESOLUTION AUTORADIOGRAPHIC APPOSITION METHOD. J. Novek (Karolinska Sjukhuset, Stockholm). Intern. J. Appl. Radiation Isotopes, 15: 485-9(Aug. 1964).

An account is given of an improved version of a method for high-resolution autoradiography in which the section is separated temporarily from the emulsion. The realignment of section and autoradiogram is performed with an error consistently less than 3 μ; the interspace is reduced to 2 to 4 μ. The method is suitable for cryostat sections, labeled with water-soluble tracers, and it permits a combination of autoradiography with certain histochemical examinations on the cellular plane. Impairment in the nuclear-track emulsion as a result of heating of section and use of stains of great intensity is avoided. (auth)

41056 LIQUID SCINTILLATION COUNTING OF PLANT ROOTS. P. Nissen and A. A. Benson (Univ. of California, La Jolla). Intern. J. Appl. Radiation Isotopes, 15: 505-7 (Aug. 1964).

A liquid scintillation spectrometer was used to determine ^{35}S uptake in excised barley roots. Increasing the amount of root shifted the β spectrum to lower energies. Curves were constructed to show the relation between count ratio and sample weight and counting efficiency as a function of sample weight. It is concluded that the simplicity and efficiency of the method offer advantages over methods used for such radioassay. (H.M.G.)

41057 THE MECHANISM OF FUNCTIONAL AND MORPHOLOGICAL CHANGES OF THE KIDNEYS IN RATS TREATED WITH UNITHIOL FOR RADIATION SICKNESS (Po^{210}). Z. I. Poluboyarinova and V. N. Streltsova. Med. Radiol., 9: No. 7, 22-7(July 1964). (In Russian)

The investigations established that the use of unithiol in ^{210}Po-affected rats increases the life expectation of animals at the expense of augmented excretion of the isotope by the kidneys and intensified reduction reactions of the organism. Under the influence of unithiol the renal function during the first 3 to 4 days shows an inhibition of diuresis, whereas in the subsequent days, polyuria of compensatory nature appears. The therapeutic effect of unithiol causes a shortening of the phase of degenerative-necrobiotic changes of the kidneys and acceleration of the reduction period. However, tissue regeneration is incomplete and does not ensure morphological and functional restoration of the affected structures of the renal nephron. The main mass of dead elements of the renal parenchyma is replaced by connective tissue with transition into nephrosclerosis. (auth)

41058 DISTRIBUTION AND FATE OF SOLUBLE PROTEINS LABELLED WITH IODINE-131 FROM RAT AND RABBIT LIVERS. V. Bocci (Instituto di Fisiologia Generale, Siena, Italy). Nature, 203: 888-9(Aug. 22, 1964).

The distribution and fate of liver ^{131}I-proteins were studied in rabbits and rats using the chloramine T and iodine monochloride (ICl) procedures for radioiodination. A considerably lower yield of protein-bound radioactivity was observed in rats when higher amounts of ^{131}I were used. When liver proteins were labeled with ^{131}I by the ICl method

52% ^{131}I-proteins were taken up by the liver, a value close to that obtained by using ^{131}I-proteins kept in contact with only 2 mg chloramine T. In rabbits total body and plasma radioactivity half lives for ^{131}I-sodium iodide and serum ^{131}I-proteins were shortened and much longer, respectively. It is concluded that the reagents used in the radioiodination procedure, if not used under carefully selected conditions, can adversely modify the biological properties of liver ^{131}I-proteins whereas little, if any, protein damage might derive from either substitution of ^{131}I or from self-irradiation. (H.M.G.)

41059 EFFICIENT LABELLING OF TISSUE-SOLUBLE PROTEINS WITH IODINE-131 USING CHLORAMINE T. V. Bocci (Instituto di Fisiologia Generale, Siena, Italy). Nature, 203: 985-6(Aug. 29, 1964).

Efforts to use chloramine T for labeling tissue-soluble proteins with ^{131}I are described. Iodine-131-tungstophosphoric acid (^{131}I-TPA) was measured in a well-type scintillation counter in the presence of carriers NaI and bovine serum proteins. Labeling efficiencies were lower for rabbit liver and kidney soluble proteins compared with those for serum proteins. An inverse relation was apparent between labeling efficiency and ^{131}I-TPA soluble radioactivity. By increasing the amount of chloramine T or by using the same amount of oxidizing agent but higher protein concentration, the labeling efficiency was reduced. When rabbit and rat protein samples were tested by starch-gel electrophoresis and a contact autoradiogram, the radioactivity appeared bound to tissue proteins, prealbumin, albumin, and globulin-like components. (H.M.G.)

41060 BONE GROWTH AND UPTAKE OF RADIOCALCIUM IN TETRACYCLINE-TREATED RATS. Robert C. Likins and Gloria A. Pakis (National Inst. of Dental Research, Bethesda, Md.). Nature, 203: 1069-70(Sept. 5, 1964).

Investigations of the effect of graded doses of tetracycline on bone growth and on the skeletal and dental uptake of radiocalcium in rats are reported. Tetracycline did not affect the growth of the femurs nor was there any indication from ash weights of effects on mass of bone, incisors, or molars. From results of radiocalcium uptake, it is further concluded that tetracycline administration had no effect on the ^{45}Ca uptake by either bone or teeth. (H.M.G.)

41061 DIURNAL VARIATIONS OF ^{14}C-LEUCINE INCORPORATION INTO PROTEINS OF ISOLATED RAT LIVER NUCLEI. Neda Sestan (Institut "Rudjer Boskovic," Zagreb). Naturwissenschaften, 51: 371(1964). (In German)

The possible existence of a "within day" difference in ^{14}C-leucine incorporation into liver nuclear proteins was investigated on normal and hepatectomized rats on a standardized regiment of alternating light and darkness. The male Wistar rats were kept at 22 to 25°C in a room illuminated from 7 a.m. to 7 p.m. and darkened for the next 12 hrs. Rats were sacrificed at 8 a.m. and 5 p.m., and liver nuclei were immediately isolated and incubated with ^{14}C-leucine. A "within day" difference was observed in both normal and regenerating liver nuclei. (J.S.R.)

41062 EFFECTS OF GADOLINIUM AND DYSPROSIUM OXIDES ON ORGANISMS. O. Ya. Mogilevskaya and T. A. Roshchina. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 3, 105-8(May-June 1964). (In Russian)

It was established previously that lethal amounts of rare earth metals and their compounds vary widely; usually, the citrates are more toxic than the chlorides. In order to evaluate the hazard involved in the handling of these elements, the effect of finely dispersed oxides, specifically of Gd_2O_3 and Dy_2O_3, which may be accidentally inhaled by workers, was examined. Experiments with mice, which were intraperitoneally injected with increasing amounts of these oxides, indicated that 5000 mg/kg weight of injected material and even 10,000 mg/kg in the stomach does not cause harmful effects. In order to study the chronic effects, guinea pigs were treated with a daily dose of 2000 mg/kg of one of the oxides for one month through the alimentary tract; it was found in this series also that the toxicity of the oxides is low. In another series of tests, white rats were treated through the trachea with a suspension of the powder in physiological solution and the animals kept under observation for periods up to nine months. Although no immediate harmful effects were noted, subsequent examination of the lungs showed changes due to the accumulation of the particles, resulting in the formation of nodules; no changes were found in the other organs. It is therefore recommended that safeguards be taken when working with fine powders of these oxides. Although no MPC (maximum permissible concentration) values were determined, it is recommended that the concentration of the oxides be kept at that proposed for rare metals, such as Mo, Zr, and W. (TTT)

41063 EFFECT OF MAGNESIUM ON UPTAKE AND RETENTION OF RADIOACTIVE STRONTIUM. I. Clark, E. A. Gusmano, R. Nevins, and S. H. Cohn (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). Proc. Soc. Exptl. Biol. Med., 116: 984-7(Aug.-Sept. 1964).

Administration of Mg^{2+} concurrently with radioactive strontium decreased significantly skeletal retention of the isotope. Mg^{2+} administration had a small but significant lowering effect on the retention of radioactive strontium when administered after the isotope was well fixed in bone. (auth)

41064 UPTAKE OF Sr^{90} BY CHLORELLA VULGARIS. I. UPTAKE OF Sr^{90} AS RELATED TO THE GROWTH OF A POPULATION. C. M. Avio, M. Rossi-Torelli, and L. Lenzerini (C.A.M.E.N., Pisa, Italy). Pubbl. Staz. Zool. Napoli, 33: 264-73(1963).

The uptake of ^{90}Sr and ^{90}Y during the evolution of a population of Chlorella vulgaris in a synthetic terrain containing ^{90}Sr in radioactive equilibrium with ^{90}Y was studied. The growth of the population was unaltered by the presence of 15×10^{-3} μc/ml of radioisotope. Two hours after inoculation the algae possessed radioactivity attributable in 0.0712% to ^{90}Sr and in 30.96% to ^{90}Y of the radioactivity present in the terrain at the beginning. The percentage of ^{90}Sr uptake increased with the same rhythm as the growth of the cellular population. At the end of the phase of logarithmic increase of the population, radioactivity in the algae represented on the average 5% of the ^{90}Sr and 91% of ^{90}Y radioactivity initially introduced in the terrain. These percentages of radioactivity corresponded to 33×10^9 atoms of ^{90}Sr and 0.16×10^9 atoms of ^{90}Y. The algae had 200 times more ^{90}Sr than ^{90}Y. The reduction of radioactivity in the terrain which at the moment of separation of the algae seemed very elevated was reduced by 5% due to the subtraction of ^{90}Sr taken up by the algae. The rate of uptake per unit, i.e., the percentage of radioactivity assumed by a single cell stabilized itself after the 7th day of culture at a mean of 34×10^{-9}. The concentration factor referred to 1 g. of algae was 1,500. (Excerpta Med., Sect. XXIII, 1: (Aug. 1964))

41065 CONTRIBUTION TO THE TECHNIQUE OF MEASURING I-131 UPTAKE IN THE THYROID. H. Luethy. Schweiz. Med. Wochschr., 93: 875-8(1963). (In German)

The influence of various measurement factors on the determination of ^{131}I uptake in the thyroid is examined. The

24-hour value is subject to uncertainty, primarily because of the unknown depth of the center of radiation, but this uncertainty should not exceed ± 5%. The same uncertainty also affects the 2-hour value. Extrathyroid activity must also be taken into consideration in this case. Conditions in the case of patients with blocked iodine uptake are considered. (auth)

41066 COMMENTS ON REPORTS: POLONIUM-210 IN CIGARETTE SMOKERS. Kenneth W. Scrable (Rutgers Univ., New Brunswick, N. J.), Francis J. Haughey, Edward L. Alexander, Edward P. Radford, Jr., Vilma R. Hunt, and John B. Little. Science, 146: 86-7(Oct. 2, 1964).

A comparison was made between previous assumptions and mathematical model of ^{210}Po in cigarette smokers with ICRP recommendations. It is suggested that Po from cigarette smoke may be a useful tracer of the movement of smoke particles in human lungs. The ICRP model for insoluble particles is based on the assumption that 12½% of inhaled particles are cleared from the lungs by absorption directly into the blood. Po in blood, urine, and bronchial lymph nodes of smokers was measured, and it was concluded that less than 5% of deposited Po is cleared directly into the blood. (P.C.H.)

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Radiation Effects

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Rats injected with either ^{238}Pu or ^{144}Ce – ^{144}Pr before receiving dietary dimethylaminoazobenzene (DMAB) appeared to have a slightly lower incidence of hepatic tumors than those that received only DMAB. (auth)

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24-hour value is subject to uncertainty, primarily because of the unknown depth of the center of radiation, but this uncertainty should not exceed ± 5%. The same uncertainty also affects the 2-hour value. Extrathyroid activity must also be taken into consideration in this case. Conditions in the case of patients with blocked iodine uptake are considered. (auth)

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41080 (HW-80500(p.127-8)) POLYVINYLPYRROLIDONE EXCRETION BY NEUTRON-IRRADIATED RATS. M. F. Sullivan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Rats exposed to fission neutrons were injected with ^{131}I-labeled PVP to measure radiation damage to the intestine. An RBE of 3 was found using death as an endpoint, the same as that obtained with PVP. Pretreatment with cysteine or AET prevented the increased gut permeability caused by exposure to either 1000 R of x ray or 275 rads of neutrons. (auth)

41081 (HW-80500(p.132-3)) ABSORPTION SPECTRA OF THE PERITONEAL FLUIDS FROM X-IRRADIATED RATS. V. H. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

After 5,000 R whole-body x irradiation, changes were detected in the absorption spectra of a peritoneal dialysate from rats. No changes were detected by this method after doses of less than 1,000 R. (auth)

41082 (HW-80500(p.138-9)) COMPARATIVE EFFECTS OF RADIATION AND COPPER TOXICITIES. Patricia L. Hackett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Toxic levels of copper, x irradiation, and a combination of the two, did not affect the tissue distribution of ^{64}Cu injected into rats in a way to suggest that effects caused by the two agents are related. Injection of high levels of copper resulted in increased liver ^{64}Cu and decreased amounts in other organs. Urinary ^{64}Cu excretion was elevated in animals receiving 20 mg/kg of copper, while blood ^{64}Cu levels were increased in animals receiving 850 R. (auth)

41083 (HW-80500(p.144-6)) AGE, TEMPERATURE, COEXISTENCE, AND X-RADIATION EFFECTS ON FLOUR BEETLES' PRODUCTIVITY. H. E. Erdman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Age, temperature, coexistence, and x radiation influenced reproductive performance of flour beetles. The performance of *Tribolium castaneum* was superior to that of *T. confusum*. (auth)

41084 (HW-80500(p.147-9)) FAST NEUTRON EFFECTS ON FLOUR BEETLES. H. E. Erdman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Effects on productivity of temperature, fast neutron irradiation, and the sex irradiated were investigated for the flour beetle, *Tribolium castaneum*. Earlier onset of reproduction and greater productivity were associated with increasing temperatures from 25 to 32°C. Exposure to fast neutrons delayed the onset of reproduction in females, and reduced the numbers of F_1 adults following male or female exposures. (auth)

41085 (HW-80500(p.150-2)) EFFECTS OF X-IRRADIATION ON LEAKAGE OF CELLULAR CONSTITUENTS FROM YEAST. R. T. O'Brien (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

X radiation exposure of yeast cells increased leakage of organic cellular constituents such as uv-absorbing materials and amino acids. Some of those constituents were identified. Glutamic acid and adenosine were the major compounds lost by the cells. Leakage and uptake of potassium by unirradiated yeast was related to the pathway of glucose catabolism. (auth)

41086 (HW-80500(p.153-6)) EFFECT OF DEUTERIUM OXIDE ON ATTAINABLE GROWTH OF YEAST. R. T. O'Brien (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The effects of D_2O on efficiency of assimilation was measured by attainable growth of yeast at various initial limiting glucose concentrations. Attainable growth of yeast with glucose limiting was only 50% of H_2O control. Deuterium-grown cells were low in RNA but had normal protein and DNA contents. (auth)

41087 (HW-80500(p.157-61)) HEMATOLOGICAL RESPONSE OF MINIATURE SWINE TO MASSIVE BLOOD REMOVAL. R. O. McClellan, Glenda S. Vogt, and H. A. Ragan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Removal of 25% of the total blood volume weekly for eight weeks resulted in minimal erythrocyte changes with no apparent differences in the response of miniature swine ingesting 125 μc ^{90}Sr/day and control animals. All three controls and one ^{90}Sr-fed animal recovered following removal of 50% of the total blood volume during a four-day period. One ^{90}Sr-fed animal failed to respond and succumbed after developing a severe anemia and leukopenia following withdrawal of 30% of the total blood volume in one bleeding. (auth)

41088 (HW-80500(p.162-6)) ENDOTOXIN-INDUCED LEUKOCYTE RESPONSE IN MINIATURE SWINE. R. O. McClellan, Glenda S. Vogt, R. E. Kane, and F. F. Hahn (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Following intravenous administration of a Pseudomonas endotoxin, miniature swine fed ^{90}Sr and their controls developed a transient lymphopenia and neutrophilia. The neutrophil response, as measured by integration of neutrophil numbers over a 48-hour period following endotoxin administration, was considered as an index of the animal's neutrophil reserve and was less in animals fed 125 μc ^{90}Sr/day than in control animals. (auth)

41089 (NYO-3319-3) FACTORS INFLUENCING RADIORESISTANCE OF MICROORGANISMS. Technical Progress Report, January 1, 1964—September 15, 1964. Alan K. Bruce (New York. State Univ., Albany. Research Foundation). Sept. 25, 1964. Contract AT(30-1)-3319. 17p.

Para-hydroxymercuribenzoate (HMB) was found to sensitize *micrococcus radiodurans* to both ultraviolet and x radiation. Results are reported from studies of binding of HMB by *M. radiodurans* cells before and after irradiation and the binding of HMB as a function of radiosensitivity of bacteria of other genera. It is postulated that a chemical radioprotective agent may be involved in the radioresistance of *M. radiodurans*. (C.H.)

41090 (TID-21097) SOMATIC MUTATIONS IN THE MOTH EPHESTIA. [Period Covered]: December 1, 1961—August 1, 1964. Ernst W. Caspari (Rochester, N. Y. Univ.). Contract AT(30-1)-2902. 64p.

Each scale of the hind wing of the moth Anagasta (Ephestia) is a single highly differentiated cell and normal variations are easily recognized. This system was used in studies of somatic mutations induced by x radiation, 5-bromodeoxyuridine (BUD), or 5-fluouracil (FU) applied to larvae 8 days after the last larvae molt. Some studies were also made on the development of the eye pigmentary system in the treated larvae and the role of DNA and RNA in the development of this system. Scale aberrations induced by BDU and x radiation showed considerable differences. Pupae treated with FU survived up to hatching time but their development was inhibited and eye pigment formation was affected. Methods are described by which relatively pure, double stranded, high molecular DNA was extracted from Ephestia larvae, pupae, and adults. Injection of DNA into larvae resulted in block scales with a frequency that indicated they were transformed cells. (50 references). (C.H.)

41091 (TID-21116) THE DETERMINATION OF THE WHOLESOMENESS OF IRRADIATION-PASTEURIZED CLAMS. Final Summary, June 1963–August 1964. Elwood F. Reber (Illinois. Univ., Urbana. Coll. of Veterinary Medicine and Illinois. Agricultural Experiment Station, Urbana). Aug. 1964. Contract AT(11-1)-1302. 77p.

The protein quality of radiation-processed haddock, flounder, crab, and soft-shelled clams were compared with those of non-irradiated frozen or heat-treated samples of the fish products. Standard chemical tests for protein efficiency ratio and 28-day feeding tests in rats were used. The irradiated foods were exposed to 3×10^6 or 6×10^6 rad ^{60}Co γ radiation. The results indicate irradiation and freezing had no effect on the protein quality or nutritional value of the fish products. Heat-treatment reduced the nutritional value of the products. Preliminary results are reported from a long-term study of the wholesomeness of a diet containing radiation-processed clams for rats. (C.H.)

41092 (TID-21125) [PROGRESS REPORT ON TUMOR INDUCTION BY RADIOACTIVE THYMIDINE]. (Northwestern Univ., Chicago. Medical School). Sept. 15, 1964. Contract AT(11-1)-1131. 7p.

Progress is reported in studies on the carcinogenic action of radioactive thymine. Thymidine labeled with either ^{3}H or ^{14}C was found to increase the incidence of tumors and shorten the life span of mice. The incidence of tumors that are rare in the mouse strain used was particularly increased and the induction time of more frequent tumors was shortened. Data are included from a study on the distribution of injected thymidine in mouse tissues, with emphasis on incorporation into DNA. (C.H.)

41093 (TID-21126) A STUDY ON THE COMBINED ACTION OF ADRENAL STEROIDS WITH X RADIATION AND CERTAIN OTHER IONIZING RADIATIONS ON GROWTH AND METABOLISM OF CERTAIN MALIGNANT CELLS IN CULTURE AND IN ANIMALS. Final Report. (Colorado. Univ., Denver. School of Medicine). [nd]. Contract AT(11-1)-1218. 4p.

Results are reported from studies on the rate of development of resistance of three human neoplastic cell lines (HeLa S$_3$B, J111, and H.Ep.2) to hydrocortisone and the growth response of these and the nonresistant cells of the same original strain to varying doses of x rays and to mercaptopurine. Malignant cells were grown on Puck's N-16 medium plus 15% calf serum. Stock cultures of all cells were maintained as monolayers in 60 mm pyrex petri dishes and incubated at 37° in a Wahmann incubator flushed continuously with approximately 5% CO$_2$. Medium was changed twice a week and cells were harvested once a week. Cell counts were done using the Coulter counter; an average of 4 counts was made. Duplicate cell protein determinations were made after each procedure. In addition, cells were stained using the May-Grünwald Gismsa technic and counts were made of the giant cells in each plate. Both resistant and non-resistant cultured cells were exposed to x radiation of 150 R, 300 R, and 450 R using a uniform technic. The cultured cells exposed to varying doses of hydrocortisone (6.25-25 ugm./ml.) showed a general increase in size and chromatin staining. Cell protein was increased and cell numbers decreased at the initial exposure. After about 4 weeks resistance began to appear and by 12 weeks the cells reached a peak of resistance. After resistance had been attained it appeared to be persistent. The response of the resistant and non-resistant cells to x ray showed a number of differences. Most noticeable was the great increase in giant cell counts of the resistant HeLa and H.Ep.2 cells on radiation exposure as compared to controls. This latter response would suggest a greater susceptibility of these cells to x ray after resistance is developed. The cultured neoplastic cells made resistant to hydrocortisone were exposed to mercaptopurine and vice versa. In this series there was evidence that H.Ep.2 cells made resistant to mercaptopurine were more sensitive to hydrocortisone than the controls. The response was not evident with the other cell types. (auth)

41094 (TID-21156) GENETIC CONTROL OF AGING AND RADIATION-INDUCED LIFE SHORTENING IN MICE. Progress Report, January 1, 1964–September 30, 1964. John B. Storer (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). Sept. 30, 1964. Contract AT(30-1)-3314. 7p.

The mean life span was determined for 21 inbred mouse strains. Preliminary results are reported from studies on the effects of doses of 250 or 450 R x radiation on the life span of mice, the rate of accumulation of chromosome aberrations with age, and the effects of genotype on radioinduced chromosome aberrations in mice. (C.H.)

41095 (FTD-TT-64-892(p.232-41)) OCCURRENCE OF CROSSING OVER IN DROSOPHILA MALES UNDER THE INFLUENCE OF VIBRATION, ACCELERATION AND γ-IRRADIATION. G. P. Parfenov. Translated from Kosmich. Issled., 2: 648-53(July-Aug. 1964).

The influence of vibration, acceleration, and γ-irradiation on the incidence of crossing over in Drosophila males is examined. It is customary to assume that this class of hereditary changes is governed by rebuilding of homologous chromosomes in the meiotic stages. This test was also used aboard artificial earth satellites to indicate the biological effect of cosmic radiation, and some results were obtained. To analyze the differences that arose, experiments were run with Drosophila specimens subjected to acceleration, vibrations, γ-irradiation, and combinations of these factors. The data obtained are discussed. (auth)

41096 CHROMOSOME INVESTIGATIONS ON THE EMBRYO PROGENY OF MALE MICE TREATED WITH ^{90}Sr. B. Henricson and A. Nilsson (Royal Veterinary Coll., Stockholm and Research Inst. of National Defence, Sunndbyberg, Sweden). Acta Radiol., Therapy, Phys., Biol. (N.S.), 2: 315-20(Aug. 1964).

Inbred, male CBA mice received intravenous injections of ^{90}Sr and were mated with normal female mice before treatment and 25, 35, 45, and 60 days afterwards. Squash preparations were made from 5 to 7 day embryos and cell division activity and the chromosome number were studied. The investigation suggested that aneuploid spermatozoa were responsible for the fertilization, or possibly, that radiation damage of the cell division mechanism was transferred from the spermatozoa to the embryos. (auth)

41097 ACTION OF IONIZING RADIATION ON MAIZE. V. N. Lysikov. Agrobiologiya, No. 1, 143-6(1964). (In Russian)

Effects of ionizing radiation were studied using freshly collected maize pollen placed in wax paper envelopes and irradiated with 4500 to 5000 R and using pollen still in the maize thyrse irradiated with 1200 to 1500 R 4 to 5 days before ripening. Morphological changes were tabulated. It was found that in the two dwarfed species used fertility and viability were retained. (R.V.J.)

41098 EFFECTS OF RADIATION ON THE LUNGS AND PULMONARY FUNCTION IN THE TREATMENT OF CARCINOMA OF THE BRONCHUS. A. Voutilainen, H. Mahonen, and A. O. Heinonen (Univ. of Helsinki). Ann. Med. Internae Fenniae, 51: Suppl. 36, 19p.(1962).

Studies were conducted before and after thoracic radiotherapy on 46 cases of bronchial cancer and one of mediastinal thymoma by the following pulmonary function tests: vital capacity (VC), maximum breathing capacity (MBC), total lung capacity (TLC), residual volume (RV), pulmonary diffusing capacity for carbon monoxide = (DL_{CO}), and functional residual volume (FRV). Thirty-two of these cases were given the full tumor dose of radiotherapy. The maximal dose to the lung was 5000 to 5500 R of x irradiation or 5500 R γ-ray therapy. The therapy was given to the four fields in the skin directly over the tumor. When the pulmonary function tests were made, the patients were also examined radiographically to assess the pulmonary radiation reactions. The pulmonary function tests were performed at the end of radiotherapy, and in some patients for a third time 3, 6, or 9 months after radiotherapy. Pulmonary function tests conducted prior to radiotherapy revealed deterioration compared with the control values. The mean VC values were at the end of radiotherapy the same as at the beginning, but the other values showed improvement. Variations in response were attributed to the reaction of the tumor to therapy and to the development of pulmonary fibrosis and the occurrence of tumor recurrence after radiotherapy. (TCO)

41099 ACTIVITY OF ACID PHOSPHATASE IN THE CASE OF IRRADIATED AMOEBA FRAGMENTS. Yvette Škreb and Bernarda Loncar (Institut de Recherches Medicales et de Médecine de Travail, Zagreb). Biochim. Biophys. Acta, 80: 523-6(Mar. 23, 1964). (In French)

Preliminary results are presented from a study on the effects of ultraviolet and γ radiation on acid phosphatase activity of fragments of *Amoeba proteus*. Both types of radiation resulted in a decreased phosphatase activity during the 4-hr period after exposure, but the effects of γ radiation were more rapid. (C.H.)

41100 PEROXIDATIVE AND RADIATION DAMAGE TO ISOLATED LYSOSOMES. I. D. Desai, P. L. Sawant, and A. L. Tappel (Univ. of California, Davis). Biochim. Biophys. Acta, 86: 277-85(May 11, 1964).

Isolated rat-liver lysosomes peroxidized at a comparatively slower rate than either mitochondria or microsomes, but when subjected to induced free radical systems like autoxidizable compounds, linoleate emulsion and hydrogen peroxide, the lysosomal membrane was found extremely labile to such damage as indicated by release of bound enzymes. Ultraviolet light and gamma radiation had also similar lysing effect on the membrane of isolated lysosomes. The differential release and inactivation pattern of various enzymes suggest differences in molecular binding and organization of these enzymes in lysosomal particles. (auth)

41101 INACTIVATION OF SOLUBLE RIBONUCLEIC ACID BY ULTRAVIOLET IRRADIATION. Faiza Fawaz-Estrup and Richard B. Setlow (Yale Univ., New Haven). Biochim. Biophys. Acta, 87: 28-33(May 18, 1964).

Yeast soluble ribonucleic acid was inactivated by monochromatic ultraviolet light in the wavelength region 2262 Å to 2894 Å. The action spectrum of soluble ribonucleic acid specific for valine, was not similar to its absorption spectrum, and hence the quantum yields for inactivation depends on wavelength. (auth)

41102 THE PHOTO-RESTORATION OF NUCLEIC ACID BIOSYNTHESIS IN THE BACTERIUM *ESCHERICHIA COLI*. Slavica Šmit and Branimir Miletić (Institute "Ruder Boskovic," Zagreb). Biochim. Biophys. Acta, 87: 54-9(May 18, 1964).

The restorative effects of visible light on the synthesis of DNA have been studied in ultraviolet-irradiated strains of *Escherichia coli*. When ultraviolet-irradiation is immediately followed by visible light, the inhibition of the synthesis of DNA disappears whether the subsequent illumination lasts for 2 or 10 min. The only difference is in the rate of restoration of DNA-synthesis. The extent of photo-restoration is not significantly diminished when an interval of 40 min is allowed between irradiation and illumination. Even if the synthesis of RNA and of protein are inhibited after irradiation and illumination, the synthesis of DNA in photo-restored bacteria is resumed after a time-lag. (auth)

41103 THE EFFECT OF X-IRRADIATION ON THE PRIMING ABILITY OF DNA IN THE RNA POLYMERASE SYSTEM. Friedrich Zimmermann, Hans Kroeger, Ulrich Hagen, and Klaus Keck (Universitat, Freiburg i. B.). Biochim. Biophys. Acta, 87: 160-2(May 18, 1964).

The effects of x radiation on the priming ability of DNA in the RNA polymerase system were examined. Data are presented on the priming ability of irradiated calf thymus DNA in the RNA polymerase system using RNA polymerase prepared from *Escherichia coli*. The system was exposed to 50 kv x radiation while stirring it in O_2 saturated solutions. The effects of irradiated DNA on nucleotide incorporation from nucleoside triphosphates into RNA were determined with the aid of ^{14}C-labeled nucleoside triphosphates. The effect of irradiated DNA on the priming ability of control DNA in the RNA polymerase system was also determined. (C.H.)

41104 THE IMMEDIATE EFFECTS OF LOCAL RADIATION ON THE CELLS IN THE PERITONEAL CAVITY OF MICE. Bruno Bercovici and Ruth M. Graham (Roswell Park Memorial Inst., Buffalo). Brit. J. Radiol., 37: 682-8 (Sept. 1964).

Studies on the peritoneal fluid of mice subjected to 375 and 465 rads of ionizing radiation delivered locally in one dose to the mouse abdomen indicate that: cells vary in their response to radiation; mast cells and histiocytes showed a definite increase at 15 minutes, and at no time was there any evidence that either cell types was damaged by radiation; and lymphocytes showed a definite decrease in numbers and abnormal morphology. (auth)

41105 PATHOLOGICAL PHYSIOLOGY AND GENERAL PATHOLOGY ON CERTAIN CHARACTERISTICS OF HIGHER NERVOUS ACTIVITY IN ANIMALS SUBJECTED TO ANTENATAL IONIZING RADIATION. REPORT VI. CHARACTERISTICS OF HIGHER NERVOUS ACTIVITY DURING THE POSTNATAL ONTOGENESIS OF RABBITS IRRADIATED WITH ROENTGEN RAYS IN THE PERIOD OF ORGANOGENESIS. I. A. Piontkovskii and R. I. Kruglikov (Inst. of Higher Nervous Activity and Neurophysiology, Academy of Sciences, USSR). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Transl.), 56: 736-9(Aug. 1964). Translated from Byul. Eksperim. Biol. i Med., 56: 35-8(July 1963).

On the 15th day after coitus female rabbits were subjected to a single x irradiation at a dose of 400 R. Stabilization of conditioned reflex activity was investigated in the progeny. Observations covered the somatic state of the animals with determination of hematological indices and inquiry into the cerebral morphology. In animals irradiated during organogenesis there is a slower elaboration and a slower stabilization of conditioned positive reflexes; differential response to sound stimulus is not elaborated. Irradiated animals differed but little from the controls in hematological and weight indices. Histological investigation disclosed a reduction of the brain mass, considerable atrophy of the cortex and its disturbed development; corpus calossum and cerebellum either absent or underdeveloped. Clinically there appeared rotational and pendulum-like movements and development of spastic paralyses of hind extremities. Brain function indices indicating subcortical formations were the ones to suffer most in these animals. (auth)

41106 THE EFFECT OF SHORT TERM AND CHRONIC IRRADIATION ON LIVER REGENERATION IN WHITE MICE. G. B. Strelin and I. V. Shiffer (Ministry of Public Health, Leningrad). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Transl.), 56: 786-9(Aug. 1964). Translated from Byul. Eksperim. Biol. i Med., 56: 87-91(July 1963).

The extent of injury of regenerating liver was compared on adult albino mice following brief and prolonged irradiation with γ rays at a dose of 1000 R. Hepatic regeneration was depressed after a single irradiation whereas after prolonged irradiation regeneration processes caused by trauma showed no significant depression. Decrease of irradiation efficacy with reduction of the dose rate may be associated either with the presence in the liver of physiological regeneration processes or with the fact that radiation sickness was not marked in prolonged irradiation of animals. (auth)

41107 DOSIMETRY FOR BIOLOGICAL PURPOSES IN A RESEARCH REACTOR. G. Ahnstroem (Universita di Stoccolma, Svezia, Italy), G. Guerrieri, M. Giacomelli, and L. Di Palo. Comit. Nazl. Energia Nucl., Notiziario, 10: No. 7, 16-21(July 1964). (In Italian)

The use of the RC-1 (Triga Mark-II type) reactor, installed at the Casaccia Nuclear Center, as a source of fast and thermal neutrons for the irradiation of biological material was studied. An attempt was also made to standardize dosimetric methods in order to make possible better cooperation among various laboratories working on the use of radiations in biology. (tr-auth)

41108 RADIATION AND CANCER. Philip Burch (General Infirmary, Leeds, Eng.). Discovery, 24: 16-21(Feb. 1963).

The evidence implicating ionizing radiation as a carcinogenic agent is reviewed, several new concepts relating to radiation carcinogenesis are critically examined, and a new theory presented. Several multistage models of carcinogenesis, which postulate that cancerous change depends on at least two discrete events, are examined. In all models except one it is suggested that the cancer cell is the result of a cumulative series of mutations. In the remaining model it is held that a mutation is present in each cell of a colony of contiguous cells and that when, as a result of a random process the colony reaches a critical size, malignant growth ensues. A new theory retaining the concept of multistage somatic mutations attempts to estimate the number, n, of somatic mutations required to initiate a given type of cancer and to calculate the frequency, m_S, with which these spontaneous mutations occur. Mathematical equations are set up in terms of n and m_S (the unknowns), and other parameters which are known. A trial value is then adopted for n and the associated value of m_S calculated, that gives agreement with mortality statistics. The process is repeated with different values of n until a reasonable value for m_S is obtained. A reliable estimate for spontaneous somatic mutation frequency in mammals is derived from observations of fleece mosaicism in sheep, for the gene concerned, the value of m_S being about 2×10^{-6}/cell/yr. A table shows the values of m_S obtained by this procedure for three types of leukemia. It is suggested that most childhood leukemias involve one inherited mutation, and that in addition to the two somatic mutations a stress factor is required to complete the leukemic transformation. This stress factor in some cases could be a virus. The calculations needed to construct dose-response curves to indicate how many mutations a given dose of radiation can cause, and whether the number will alter with varying conditions, are considered. The findings of detailed investigations of leukemia induction by ionizing radiation were used to calculate from theory the implied value of α, and the results of such calculations are tabulated. (TCO)

41109 REDUCTION OF MITOTIC DELAY IN IRRADIATED SUSPENSION CULTURES OF RAT THYMOCYTES BY AN ELEVATED SALT CONCENTRATION. J. F. Whitfield, H. Brohee, and T. Youdale (C.C.R. Euratom, Ispra, Italy). Exptl. Cell Res., 35: 207-10(June 1964).

Increasing the concentration of NaCl in the medium of thymocyte cultures from 0.12 to 0.15 M after irradiation with 225 and 300 R reduced the duration of the initial mitotic delay. This procedure had no effect on cultures irradiated with 150 R. (auth)

41110 RESTITUTION OF RADIATION-INDUCED CHROMOSOMAL DAMAGE IN CHINESE HAMSTER CELLS RELATED TO THE CELL'S LIFE CYCLE. W. C. Dewey and R. M. Humphrey (Univ. of Texas, Houston). Exptl. Cell Res., 35: 262-76(July 1964).

Chinese hamster cells growing in vitro were pulse-labeled for 10 min with ^{3}H-thymidine, irradiated immediately thereafter, and fixed either 4 or 11 hr later. Autoradiographic stripping film was applied to the slides to distinguish cells which were synthesizing DNA at the time of irradiation (S cells) from those cells which were in the phases preceding and following DNA synthesis (G_1 and G_2 cells, respectively). By analyzing the frequency of the G_1 cells which contained both chromosome and chromatid exchanges in the same cell, it was shown that there was not a significant number of G_2 cells mixed with the G_1 cells at the time of sampling. The percentages of exchanges which were of the chromosome type were 0 for the G_2 cells, 7–9 for the early S cells, and 54–71 for the G_1 cells. The restitution of chromosomal breaks was observed in the 11-hr samples by the frequency of chromosome and chromatid exchanges following two equal doses (300 rads) of radiation, as a function of the time interval between the two doses. If the breaks remained open during the time interval between the two doses, the frequency of exchanges was proportional to the square of the total dose; however, if restitution was completed before the second dose was administered, the effects of the two doses were only additive. When 600 rads were delivered over a period of 1 min, the S and G_1 cells had the same number of exchanges per cell (1.05); this number was four times that observed for 300 rads. However, when 600 rads were delivered over an interval of 5 to 60 min, the number of exchanges observed in the S cells remained the same while the number in the G_1 cells were reduced by one half (to 0.56). Therefore, in cells irradiated in the S phase, the breaks remained open, and no restitution occurred for at least 1 hr following irradiation; whereas in cells irradiated in the G_1 phase, restitution was completed within 5 min postirradiation. (auth)

41111 EFFECT OF CYSTEINE AND GLYCEROL ON CAPACITY OF IRRADIATED CELLS OF *ESCHERICHIA COLI* B FOR PHAGE T3. F. Hercik (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 10: 307-11(1964).

Glycerol and cysteine had a protective effect on survival of *Escherichia coli* B and *E. coli* B/r cells irradiated with x rays (50 kv). Glycerol gave the highest DRF values (7.9 for *E. coli* B and 1.8 for *E. coli* B/r). In *E. coli* B/r irradiated with alpha rays, the DRF value for glycerol was 3.3. Neither substance influenced the capacity of x irradiated *E. coli* B for phage T3, however. It can therefore be concluded that the structures and processes important for capacity are protected by internal radioprotectors or are in a reduced state, as distinct from structures which determine survival of the bacteria. If glycerol causes dehydration of the irradiated bacteria, this has no significance for the capacity of *E. coli* for phage T3. (auth)

41112 AMINO ACID DEPENDENT REGULATION OF RNA SYNTHESIS. EFFECT OF STARVATION AND OF IONIZING RADIATION INJURY ON RNA SYNTHESIS IN RAT LIVER CELLS. M. Bezdek (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 10: 312-18(1964).

Five days' starvation resulted in rats in a decrease in the RNA content of the cytoplasm and nucleus of liver cells. Synthesis of new RNA was induced in liver cells by the intraperitoneal administration of a solution containing amino acids. Amino acids probably participate in regulation of the amount of RNA in the nucleus and cytoplasm of the liver cell. Moderate doses of ionizing radiation did not influence amino acid dependent regulation of RNA synthesis. (auth)

41113 IRRADIATION NEARS REALITY. Joseph W. Slavin (Bureau of Commercial Fisheries Technological Lab., Gloucester, Mass.) and P. Miller. Food Eng., 36: 92; 94; 98(Jan. 1964).

Design features are described of the Marine Products Development Irradiator (MPDI), Gloucester, Mass. The facility was designed for the radiation processing of fish and shellfish products and employs a 250,000 C ^{60}Co γ source capable of treating 1,000 lb/hr of fish products at a level of 500,000 rads. The product is transported into and out of the γ cell by high-speed conveyor and a slower conveyor moves the product through the radiation zone. Cold storage rooms and filleting area are used for storage and preparation of fish products. The packaged irradiated fish are kept at 33°F until ready for acceptability tests. The MPDI will be used to obtain information on the commercial feasibility and cost of processing and distributing irradiated seafoods. Marine products of various types will be packaged according to different methods and irradiated at dose levels found to be most satisfactory. The irradiated fish will be subjected to large-scale acceptability tests by cooperating government agencies or private consumer groups. The irradiated seafood will also be subjected to large-scale packaging and distribution studies to determine the effect of commercial handling conditions on the quality of the product. (C.H.)

41114 FROM RADIATION ABSORPTION TO BIOLOGICAL EVENTS. Hedi Fritz-Niggli (Strahlenbiologische Laboratorium des Kantonsspitals, Zurich). Hippokrates (Stuttgart), 34: 2-9(Jan. 16, 1963). (In German)

The chain of events leading to the biological effects of radiation is discussed in terms of physicochemical metabolic effect, alteration of biological systems, and observed biological effects. Factors influencing biological radiation effects are considered. (H.M.G.)

41115 PHENOTYPIC EFFECTS OF INDUCED MUTATIONS AT THE Q LOCUS IN FREE-THRESHLING HEXAPLOID *TRITICUM* SPECIES. M. V. Prabhakara Rao and M. S. Swaminathan (Indian Agricultural Research Inst., Delhi). Indian J. Genet. Plant Breeding, 23: 232-40(Nov. 1963).

Mutations affecting the Q locus were isolated from M_2 progenies of *Triticum vulgare*, *T. compactum*, and *T. sphaerococcum* grown from seeds exposed to doses of 16,000 to 22,000 rads x radiation or β particles from ^{32}P and ^{35}S. The mutations are described and the phenotypic effects of induced mutations in wheat are discussed. (C.H.)

41116 STUDIES ON THE EFFECTS OF IONIZING RADIATIONS IN DIPLOID AND TETRAPLOID SPECIES OF GOSSYPIUM. D. Jagathesan and G. R. K. Sastry (Indian Research Inst., Delhi). Indian J. Genet. Plant Breeding, 23: 290-9(Nov. 1963).

The relationship between polyploidy and radiosensitivity was studied in different species and varieties of diploid and tetraploid cotton. Diploids were less tolerant to radiations than tetraploids when germination and survival, cytological effects, pollen, and seed fertility were used as criteria for measuring radiosensitivity. In tetraploids, a considerable amount of difference between varieties of *G. hirsutum* and *G. barbadense* was observed. (auth)

41117 VARIABLE EXPRESSIVITY OF AN INDUCED DOMINANT MUTANT OF COSMOS. R. S. Rana, H. K. Jain, and S. K. Nerwal (Indian Agricultural Research Inst., Delhi). Indian J. Genet. Plant Breeding, 23: 325-30(Nov. 1963).

Variation in flower form in Cosmos plants raised from x irradiated seed is described. A genetic analysis shows that the induced condition of doubleness is determined by a dominant mutation. The variable expressivity of this mutant gene results, however, in a phenotypic segregation which simulates to a considerable degree the non-discrete segregation characteristic of quantitative traits. The analysis indicates that this variability is a function of the differing genetic backgrounds of the individual plants. It is suggested that expressivity of differences of this type may be more common than is generally realised and may partly account for the failure to recognise discrete segregation of genes involved in determination of quantitative traits. (auth)

41118 SURVIVAL-CURVES OF SOLID TRANSPLANTABLE TUMOUR CELLS IRRADIATED *IN VIVO*: A METHOD OF DETERMINATION AND STATISTICAL EVALUATION; COMPARISON OF CELL-SURVIVAL AND ^{32}P-UPTAKE INTO DNA. Kelly H. Clifton and Norman R. Draper (Univ. of Wisconsin, Madison). Intern. J. Radiation Biol., 7: 515-35(Dec. 1963).

Methods for estimation of the 37 per cent dose (D_{37}) of mammalian cells *in vivo* have depended on the use of neoplasms from which suspensions of single cells can be readily prepared. The method presented is based on the quantitative relationship between the volume of viable tumor cells in the transplant inoculum and the latency, the time elapsing from grafting until tumours are detectable. The procedure does not involve preparation of single-cell suspensions, and the data obtained are amenable to statistical evaluation. The *in vivo* D_{37} values for C3H/WR mouse adenocarcinoma strain MTG-B were 352 rads (95 per cent confidence limits: 304–401 rads) and for carcinoma 755, 319 rads (268–368 rads). The inhibition in the incorporation of radio-orthophosphate into the deoxyribonucleic acid of tumor strain MTG–B determined in one experiment did not reflect the degree of radiation-induced damage to the cell-population. (auth)

41119 RADIATION-INDUCED AGGREGATION OF BOVINE PANCREATIC RIBONUCLEASE. Raymond Shapira (Emory Univ., Atlanta). Intern. J. Radiation Biol., 7: 537-48(Dec. 1963).

Purified bovine pancreatic ribonuclease in aqueous solution at a concentration of 10 mg per millilitre aggregated when exposed to ^{60}Co gamma radiation. Aggregation was demonstrated by Sephadex chromatography. The aggregation process was inhibited by oxygen and by chemical protective agents. In the presence of oxygen, partially oxidized, partially-active ribonuclease was formed during irradiation. In the absence of oxygen, aggregated, enzymically-inactive protein was produced. 3,3′-guanidinopropyl disulphide (GPD) completely inhibited the aggregation process. Aggregation of irradiated ribonuclease was observed in solutions of pH 1 to 8. Irradiation of lyophilized, dry ribonuclease failed to produce aggregate. Fragmentation products from irradiated protein were not observed with Sephadex G-25 chromatography. Performic-acid-oxidized ribonuclease also formed aggregates upon irradiation. Total amino-acid analysis of the aggregate indicated that one lysine residue of the enzyme was chemically altered in the aggregate. A mechanism for radiation protection by chemicals based upon the ability of these chemicals to terminate the aggregation process is suggested. (auth)

41120 CHROMOSOME ABERRATIONS IN PROTEMNODON BICOLOR AFTER IRRADIATION. I. IRRADIATION IN THE PREMITOTIC PERIOD. Ruth Moore (Radiobiological Research Univ., Melbourne) and G. Gregory. Intern. J. Radiation Biol., 7: 549-60(Dec. 1963).

An analysis was made of interchromosomal chromatid exchanges after irradiation of cultures of peripheral blood from a specimen of Protemnodon bicolor ♂ in the premitotic period. The number and distribution of points of interchanges show that they occur at random within and between chromosomes, indicating that, unlike the cells of certain plant species investigated, the chromosomal elements in these cells are completely unorganized during later interphase. (auth)

41121 INDUCTION OF TOLERANCE TO MATERNAL SKIN-GRAFTS IN RATS IRRADIATED DURING THE FOETAL LIFE. S. Kečkeš and N. Allegretti (Institut "Rudjer Bošković," Zagreb). Intern. J. Radiation Biol., 7: 561-7 (Dec. 1963).

Two months old rats, irradiated during foetal life, show specific tolerance towards skin-grafts from their mother. The degree of the tolerance is proportional to the dose of radiation. (auth)

41122 RELATIONSHIP BETWEEN URINARY EXCRETION-RATE OF 5-HYDROXYINDOLEACETIC ACID AND SURVIVAL-TIME OF X-IRRADIATED RATS. Ž. Deanović and Z. Supek (Institut "Rudjer Bošković," Zagreb). Intern. J. Radiation Biol., 7: 569-74(Dec. 1963).

The relationship between the excretion-rate of urinary 5-hydroxyindoleacetic acid (5-HIAA) and the survival-time of rats irradiated with 800 R is presented. The groups of rats showing a greater increase in excretion-rate of 5-HIAA after irradiation had a longer survival-time. Between these phenomena there is a highly significant positive correlation. The results are discussed, and some possible interpretations attempted. (auth)

41123 THE INCORPORATION OF THYMIDINE INTO DNA AND EFFECTS OF γ-RADIATION. I. EXPERIMENTS WITH ASCITES CELLS IN VITRO. A. R. Crathorn and K. V. Shooter (Royal Cancer Hospital, London). Intern. J. Radiation Biol., 7: 575-85(Dec. 1963).

Labeled thymidine is incorporated into Krebs II ascites cells in vitro for a limited period only. It was shown that this failure results from a progressive decay in the activity of the enzymes which phosphorylate thymidine. Irradiation with 10,000 R reduces the rate of incorporation of thymidine into the cells and lowers the total amount bound in DNA during the period in which the cells remain metabolically active. The effect of the radiation cannot be attributed to a lack of availability of the precursor within the cells, nor to any damage resulting in loss of activity of the thymidine kinases. It is suggested that radiation slows down the incorporation of tritium-labeled thymidine phosphorylate TTP into DNA and that the observed kinetics of the phosphorylation reactions can be explained in terms of competitive inhibition of the thymidine kinase by TTP. (auth)

41124 EFFECTS OF CONTAMINATION BY STRONTIUM-90 ON GROWING RATS. B. Graf and J. Lafuma (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Intern. J. Radiation Biol., 7: 601-17(Dec. 1963). (In French)

Effects of ^{90}Sr contamination by an intramuscular path on the skeleton were studied in rats during a period of active growth. Two series of rats received respectively 4 and 2.7 μC/g of a ^{90}Sr solution. Autoradiographs show that ^{90}Sr has a metabolism analogous to that of calcium and becomes fixed in regions of active growth. Calculations and experimental data underline the necessity of finding thin bone sections (10μ) to obtain good microscopic location. Comparison of autohistoradiographs and histopathological examinations verified that the bone lesions are situated principally in zones of strong radioactivity and in their environs (epiphyseal cartilage, first spongy cartilage, internal half of the diaphysis). When the activity is too high (4 μC/g), destruction is more severe, extending beyond the zones of fixation. Medullary aplasia and bone necrosis are the histological manifestations. The rats succumb in 8 to 10 days. For a dose of 2.7 μC/g, a resumption of growth was observed, in spite of the initial lesions. Proof of this is given, in the autohistoradiographs, by the displacement of zones of strong radioactivity which appear just after the injection. (tr-auth)

41125 PROPERTIES AND NATURE OF TOXIC SUBSTANCES IN THE GASTRIC JUICES AT THE TIME OF RADIATION INJURY. S. A. Hakopyan and L. Kh. Kirakosyan. Izv. Akad. Nauk Arm. SSR, Biol. Nauki, 15: No. 12, 15-24(1962). (In Armenian)

The nature and properties of toxic substances in the gastric juices of irradiated dogs were studied by observing toxin activity, effects of temperature on the toxins, and the effects of the toxins on the growth and development of wheat seeds and maize roots. The obtained data showed that during acute radiation sickness the toxic substances in the gastric juices retain their activity from 30 to 60 min, are destroyed at high temperature, and depressed the growth of wheat seeds and the growth and development of maize roots. (R.V.J.)

41126 GERMINATION AND RESPIRATION INTENSITY OF CORN SEEDS IRRADIATED UNDER AIR-DRY CONDI-

TIONS WITH COBALT-60. N. V. Romenskii, A. D. Chmyr, S. A. Abramova, and A. N. Belostotskaya (Lomonosov Tech. Inst., Odessa). Izv. Vysshikh Uchebn. Zavedenii, Pishchevaya Tekhnol., No. 4, 17-19(1963). (In Russian)

Maize seed exposure in dry air to 5×10^3 and 10^4 R stimulated germination, while stronger doses (10^5 R) inhibit germination. Oxygen absorption is stimulated in germinating seed exposed to 5×10^3 R. The respiratory coefficients for germinating seeds exposed to 10^4 and 10^5 R were also increased. (R.V.J.)

41127 EFFECT OF TEMPERATURE ON RADIOSENSITIVITY OF SALMONELLA TYPHIMURIUM. Joseph J. Licciardello (Massachusetts Inst. of Tech., Cambridge). J. Food Sci., 29: 469-74(July-Aug. 1964).

An investigation was designed to determine the radiosensitivity of bacterial cells at elevated temperatures and also to compare the lethal effect of simultaneous irradiation and heating with irradiation and heat applied in succession. Sensitivity of S. typhimurium to ^{60}Co γ radiation increased as a function of irradiation temperature from 32 to 130°F, the greatest effect of temperature during irradiation occurring at temperatures above 110°F. Rate of bacterial destruction was significantly greater when the ionizing and thermal energies were applied simultaneously than when they were applied consecutively. Thus, bacterial cell destruction was significantly greater when irradiation was carried out at 130°F than when the cells were irradiated at 32°F and then heated for an equivalent time at 130°F. Results were similar for survival rates of 100°F. Similar results were obtained with irradiation of bacteria in whole egg and in egg yolk. It was indicated that the organism is more resistant in egg yolk. The increased resistance in egg yolk is probably dependent on the low pH of the egg yolk. Various theories proposed to explain the increased radiosensitivity at high temperatures are discussed, including: increased diffusion of free radicals; excitation, which is not considered important at low temperatures, but becomes of importance at high temperatures; increase in target size due to thermal expansion; formation of new radical species; and increase in bond length at high temperature which makes molecules unstable. It is concluded that each of these factors may play a minor role in contributing to the total effect. (TCO)

41128 EFFECTS OF RADIATION FACTORS ON TRADESCANTIA PALUDOSA MICROSPORES DURING COSMIC FLIGHTS OF VOSTOK-3 AND VOSTOK-4 SATELLITES. M. L. Delone, P. R. Popovich, V. V. Antipov, and V. G. Vysotskii. Kosmich. Issled., 1: 312-25(Sept.-Oct. 1963). (In Russian)

Effects of radiation on Tradescantia paludosa microspores were recorded in such a manner as to eliminate effects of vibration, acceleration, and landing. An analysis revealed a new type of rearrangement of spherical fragments in the metaphase, anaphase, body phase, prophase, and interphase. Variable mitosis disturbance was also observed. (tr-auth)

41129 THE INFLUENCE OF COSMIC FLIGHT FACTORS ON THE FREQUENCY OF SEX-LINKED RECESSIVE LETHAL MUTATIONS IN DROSOPHILA MELANOGASTER. Ya. L. Glembotskii, Yu. A. Lapkin, G. P. Parfenov, and E. M. Kamilova. Kosmich. Issled., 1: 326-34(Sept.-Oct. 1963). (In Russian)

Experiments carried out during Vostok-3 and -4 flights revealed various types of mutations in Drosophila melanogaster. Data from these flights were correlated with data obtained during five previous flights. In spite of the great variety of reactions found, a certain parallelism was observed in the heredity of insects exposed to the same conditions. Weightlessness, vibrations, acceleration, and cosmic radiation are postulated to combine and produce some variations in mutagenic reactions. (R.V.J.)

41130 USE OF STATISTICAL PROCEDURES FOR MATERIAL TREATMENT IN THE EVALUATION OF RADIATION INJURY DEVELOPMENT. A. G. Vasilenko. Lab. Delo, 2: 3-8(1963). (In Russian)

Statistical analyses confirmed a direct correlation between the leukopenia, auto-infection, and the time after radiation injury in animals. (R.V.J.)

41131 SOME MODIFICATIONS IN THE LUMINESCENCE OF CELLS AFTER THE ADMINISTRATION OF I^{131}. N. K. Sviridov, O. S. Sergel', and I. S. Kas'yanov. Lab. Delo, 2: 8-9(1963). (In Russian)

Short-duration damage to blood cells and marrow induced by tracer doses of ^{131}I was revealed by luminescence analysis. It is suggested that the appearance of bud-shaped degenerate cells in the marrow and peripheral blood of animals should be considered during the evaluation of blood and marrow luminescence in irradiated organisms. (R.V.J.)

41132 THE SIGNIFICANCE OF CHANGES IN PLASMA IRON CLEARANCE FOLLOWING EXPOSURE TO IONIZING RADIATION IN THE DOG. Merton A. Quaife and Lawrence T. Odland. Laval Med., 35: 414-18(Apr. 1964).

Plasma-iron clearance half-time was utilized as a parameter of measurement of the effect of wave and particle irradiation on the hematopoietic system of the beagle. The significance of changes between irradiated and nonirradiated groups is noted. Some possible prognostic implications of the changes following exposure to either wave or particle irradiation are discussed. Preliminary evidence suggests some difference in effect between the two radiation forms in subjects succumbing to the radiation insult, with x irradiation being the more damaging. The higher mortality rate from x ray lends some support to this suggestion. (auth)

41133 THE CHANGES OF SOME BIOCHEMICAL INDICES DURING A COMBINED (RADIATION AND THIAMINE PREPARATIONS) THERAPY IN AN ONCOLOGICAL EXPERIMENT. A. Malachovskis and S. Zimanaite. Lietuvos TSR Sveikatos Apsaugos Min., Onkol. Inst. Darbai, 2: 179-90(1961). (In Lithuanian)

The combined effects of thiamine and doses of whole-body x radiation of 350, 490, and 600 R on metabolic processes and growth of sarcomas in rats were evaluated. Irradiation of tumor-bearing rats inhibited tumor growth but caused disturbances of metabolic processes. When thiamine preparations were given before and after exposure to median radiation doses tumor growth was retarded and metabolic disturbances soon returned to normal. Large radiation doses combined with thiamine preparations caused a marked reduction in tumor growth but produced metabolic disturbances that did not return to normal during the life of the animals. It was concluded that thiamine preparations do not stimulate tumor growth and have a useful role in the radiotherapy of cancers. (C.H.)

41134 THE CORRELATION OF SOME EFFECTS (BLASTOMATOGENIC, TUMEFACIENT AND LIFE SHORTENING) DURING THE ACTION OF IONIZING RADIATION. R. V. Smirnov (Central Scientific Research Inst. of Medical Radiology, Ministry of Health, USSR). Med. Radiol., 9: No. 7, 32-7(July 1964). (In Russian)

Single gamma irradiation of mice in doses of 100, 200, 400, 600, and 800 R produced an accelerated development of myeloid leukemia and milk-duct tumors. The degree of shortening of the latent period of neoplastic development depended not only on the irradiation dose, but also on the type of neoplastic process. A confrontation of curves, reflecting alteration of the latent period of neoplastic development and life expectation of mice in different irradiation doses, showed that the blastomatogenic effect was not only the sequence of shortened life expectation of animals. The various combination of the tumefacient and blastomatogenic action of radiation in the development of myeloid leukemia, tumors of the mammary gland, ovaries and pulmonary adenomas, testifies to the independence of these aspects of the biological action of ionizing radiation. The blastomatogenic influence of radiation is, apparently, the result of specific disturbances caused by irradiation mainly in the endocrine system and is not associated with activation of metabolic processes in the organism. (auth)

41135 ON THE VARIATIONS IN NUMBER AND STAINABILITY OF MAST CELLS IN CONNECTIVE TISSUE OF RAT SKIN AFTER IONIZING IRRADIATION (PLESIOTHERAPY). L. Bruni and A. Mazza (Università, Pavia, Italy). Minerva Dermatol., 37: 220-5(June 1962). (In Italian)

A histologic study was made of the influence of x irradiation on mast cell counts in skin and their metachromatic staining reactivity. Three groups (each of 20) of adult rats received 1000, 2000, or 3000 R over a circular 3.5-cm area of the dorsal skin from an x-ray tube operated at 60 kv at a rate of 196 R/min. From each group, four animals were sacrificed at 1, 2, 5, 10, and 25 days after irradiation; 8 control animals were examined. Specimens of skin were fixed in Carnoy fluid and sections stained in aqueous solutions of toluidine blue (1 : 10,000 to 1 : 2,000,000). Mast cells were counted in each section and an area of epidermis and dermis was measured in order to express the results in area of section per mast cell (in μ^2). Average values of 10 sections per animal are given. The metachromatic reaction was stronger in the granules of mast cells after 1000 R than in controls, of similar intensity after 2000 R as in controls, and weaker after 3000 R than in controls, at all observed time intervals. It is concluded that irradiation of skin decreases the number of mast cells in rats and modifies their metachromatic reactivity. (BBB)

41136 VARIATION OF THE RELATIVE SENSITIVITY OF CLOSELY RELATED NEOPLASTIC CELL LINES IRRADIATED IN CULTURE IN THE PRESENCE OR ABSENCE OF OXYGEN. László Révész and Bo Littbrand (Karolinska Institutet, Stockholm). Nature, 203: 742-4 (Aug. 15, 1964).

Results are reported from a series of experiments in which cultures of an Ehrlich ascites tumor and its selected sublines were exposed to different doses of x radiation in oxygen or argon and the slope constant and extrapolation number of survival regressions and mean lethal dose calculated. It was concluded that differences observed between the cell lines with regard to the relative radiosensitivities under aerobic and anaerobic conditions imply a differential enhancement of the effectiveness of radiation by oxygen. (C.H.)

41137 EXPERIMENTAL MYOPATHIC SYNDROME ASSOCIATED WITH PITUITARY ACTIVATION OF THYMUS. George J. Svet-Moldavsky, Ninelle Spector, and Lucie Ravkina (Inst. of Experimental and Clinical Oncology, Moscow). Nature, 203: 771-2(Aug. 15, 1964).

Rats were irradiated with 200 R ^{60}Co γ radiation and then intrathymically implanted with the anterior pituitary. Unusual activation of the epithelial structure was observed microscopically in tissue sections. Observations are reported on non-irradiated rats in which minute pieces of rat pituitary were surgically administered to the thymus of each animal. More than 75% of the experimental animals became depressed, constrained, and motionless, with enforced aspiration, by the 14th to 60th day. These symptoms revealed a disease resembling myasthenia in humans. It is concluded that an endocrine relationship exists between the thymus and hypophysis and that this relationship is involved in the etiology of myasthenia gravis. (C.H.)

41138 PALATINOSE ELEMENT OF THE RECEPTOR OF THE MELEZITOSE LOCUS IN SACCHAROMYCES. Donna S. Hwang and Carl C. Lindegren (Southern Illinois Univ., Carbondale). Nature, 203: 791-2(Aug. 15, 1964).

Studies on Saccharomyces mutants obtained by ultraviolet irradiation indicate that palatinose can induce a melezitase that hydrolyses palatinose, as well as other glucosides. Reaction mechanisms are discussed. (C.H.)

41139 RADIATION-INDUCED CHANGES IN METABOLISM OF THYMINE IN RAT. T. H. Bates, Christine I. Smith, and Hylton Smith (Atomic Energy Authority, Dumfriesshire, Scotland). Nature, 203: 843-5(Aug. 22, 1964).

To investigate whether changes in liver function modify the excretion pattern, radioactive thymine was administered to x-irradiated rats and the excretion of radioactive metabolites was determined. By using two ^{14}C-labeled forms of thymine, it was possible to compare rates related to the formation and destruction of β-amino-isobutyric acid (BAIBA). The excretion of $^{14}CO_2$ was found to be similar in irradiated and nonirradiated groups, 90% of the injected radiocarbon being recovered in the expired air within 4 hrs after injection. Thus the degradation of thymine to the point of ring cleavage was not affected by liver damage as a result of irradiation. In further experiments thymine labeled in the methyl group was injected into rats 24 hrs post-irradiation, and excretion in expired air and urine was determined. Similar quantities of $^{14}CO_2$ were excreted in irradiated and nonirradiated animals. However, in the five days post-irradiation almost twice as much ^{14}C activity was found in the urine of liver-irradiated rats as in the controls. It is concluded that irradiation involving moderate liver damage does not alter the rate of catabolism of thymine to BAIBA, but thereafter, accumulation of the metabolites of BAIBA occurs with the formation of carbohydrates as pyruvates, which are gradually metabolized during 4 to 5 days after injection with the liberation of ^{14}C compounds predominantly in the urine. (H.M.G.)

41140 REDUCTION IN RATE OF GROWTH OF HAIR IN MICE AS AN INDICATOR OF EXPOSURE TO CHRONIC LOW DOSAGE IONIZING RADIATION. D. C. Chow, S. Rothman, A. L. Lorincz, F. Malkinson, and A. Sandburg (Univ. of Chicago). Nature, 203: 847-8(Aug. 22, 1964).

Observations are reported indicating that, in mice, the rate of regrowth of hair after plucking is a sensitive, rapid, and simple, dose-dependent biological index to damage caused by chronic, low doses of gamma radiation and fast neutrons. (H.M.G.)

41141 ELECTRON SPIN RESONANCE INVESTIGATIONS OF ULTRA-VIOLET AND X-IRRADIATED BOVINE SERUM ALBUMIN. R. Koch and H. Moenig (Universität, Freiburg i. B.). Nature, 203: 859-60(Aug. 22, 1964).

Polycrystalline native bovine serum albumin was x-irradiated, and an electron spin resonance signal was obtained that was composed of a sulfur pattern and an unresolved doublet previously described. The radical concentration of the x-irradiated albumin was 3.6×10^{17} spins/g. On exposing the irradiated serum albumin to ultraviolet light, the radical concentration was increased immediately. Increasing the wave-length of the ultraviolet radiation did not alter the radical concentration of the x-irradiated bovine serum albumin. It is suggested that the site of the radical which gives rise to the doublet is shifted by the additional energy from the uv light. Sulfuretted hydrogen was also formed with uv of 254 mμ and longer. (H.M.G.)

41142 RECOVERY FROM X-RAY INJURY AND THE EFFECT OF OXYGEN. Bo Littbrand and László Révész (Karolinska Institutet, Stockholm). Nature, 203: 889-91 (Aug. 22, 1964).

In vitro cultures of Ehrlich ascites tumor cells were used to test the possibility that fractionated irradiation of anoxic cells leads to a decrease in or lack of recovery. Results showed a differential effect of fractionated irradiation with regard to the recovery phenomenon of the cells, depending on the presence or absence of oxygen during treatment. (H.M.G.)

41143 EFFECT OF ALKYLATING AGENTS AND WHOLE-BODY X-IRRADIATION ON THYMUS. Ailene Herranen (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). Nature, 203: 891-2(Aug. 22, 1964).

The effects of whole-body x-irradiation and methylbis[β-chloroethyl]amine hydrochloride (Mustargen) on amino-acid incorporation in thymus nuclei and cytoplasmic microsomal and 5 • 1P fractions are reported. Gross observation of the presence of nuclear products in cytoplasmic fractions at early times after treatment with these agents indicates that disruption of damaged nuclei must be considered in interpreting changes in enzyme activities in all cell fractions. Data on incorporation of amino-acid by intact nuclei and the microsomal, ribosomal fractions suggest that shortly arter x-irradiation or Mustargen treatment when in vitro amino-acid incorporation by nuclei is inhibited, incorporation by the ribonucleoprotein particles in the ribosomal fraction is not inhibited. (H.M.G.)

41144 RADIATION INACTIVATION OF THE IMMUNOLOGICAL AND BIOLOGICAL ACTIVITIES OF HUMAN CHORIONIC GONADOTROPIN. William E. Paul and William D. Odell (National Cancer Inst., Bethesda, Md.). Nature, 203: 979-80(Aug. 29, 1964).

Bioassay and immunoassay methods for measuring radioinduced inactivation rates of human chorionic gonadotropin (HCG) were compared. Irradiation was accomplished by exposure to a 2.0-Mev electron beam for varying lengths of time. The irradiated hormone was bioassayed by means of the prostate and testes weight responses in immature hypophysectomized male rats. Immunological assays of HCG were performed by two methods: by the technique of Boyden using HCG-sensitized tanned, formalinized sheep erythrocytes and by a modification of the radioimmunoassay described by Feinberg and by Skom and Ralmage utilizing an HCG preparation of 12,000 I.U./mg for radioiodination. A linear relation between the logarithm of percentage of activity remaining and the radiation dosage obtained for both immunological and geological data was demonstrated. The rate of inactivation was consistently greater when assayed biologically than when measured immunologically. It is concluded that the structural unit required for immunological activity of HCG is considerably smaller than the unit required for biological activity. (H.M.G.)

41145 VARIATIONS IN RADIOSENSITIVITY OF A MAMMALIAN CELL LINE WITH PHASE OF THE GROWTH CYCLE. H. Madoc-Jones (Royal Cancer Hospital, Sutton, Surrey, Eng.). Nature, 203: 983-4(Aug. 29, 1964).

Radiosensitivity variations in the growth cycle of rat sarcoma cells are described. Fluctuations in radiosensitivity were noted through the various phases, the value of the 37% survival dose (D_0) being similar for cells in the middle of the lag and log phases. A pronounced maximum of D_0 was evident as cells passed through the lag to the log phases. Cells in the stationary phase were the most radiosensitive and had different types of survival curves. The variations in radiosensitivity through the phases of the growth cycle were believed to be related to changes in the metabolic state of the cell. (H.M.G.)

41146 RETENTION OF IMMUNOLOGICAL INFORMATION. Nature, 203: 1039-45(Sept. 5, 1964).

Experiments concerned with the immune responses of syngeneic and allogeneic mouse radiation chimeras to sheep erythrocytes are described. An attempt was made to determine whether residual immunological activity after irradiation and bone marrow therapy is necessarily attributable to persisting host cells. Male mice immunized to sheep red cells either actively or passively were given an LD_{99} radiation dose of 850 R and within 5 hrs post-irradiation injected intravenously with allogeneic or syngeneic bone marrow. Cytological and serological checks on chimerism indicated that the erythropoietic system of the allogenic chimeras and the dividing cells in the spleens of the immunologically stimulated syngeneic chimeras were donor type. (H.M.G.)

41147 A CELLULAR COMPONENT OF THYMIC FUNCTION. Elizabeth Leuchars, A. Marjorie Cross, A. J. S. Davies, and Valerie J. Wallis (Royal Cancer Hospital, London). Nature, 203: 1189(Sept. 12, 1964).

To determine whether donor cells are responsible for the recovery of the primary immune response in thymus-grafted animals, CBA mice were thymectomized, irradiated, and injected with syngeneic bone marrow cells. On the day of irradiation, each mouse was grafted with a single thymus lobe. At 28 days the animals were challenged with sheep erythrocytes. A significant increase in the number of marked donor cells was found in the spleens of the injected mice, indicating that cells presumably derived from the thymic graft were capable of dividing in response to antigenic stimulation. (H.M.G.)

41148 CHANGES IN THE POLAROGRAPHIC ACTIVITY OF CYTOPLASMIC PROTEINS UNDER THE EFFECTS OF IONIZING RADIATION. L. M. Buruiana (Faculty of Veterinary Medicine, Bucharest). Naturwissenschaften, 51: 314(1964). (In German)

The liver, kidney, heart, and brain of healthy adult rats and guinea pigs were removed immediately after decapitation. The organs and homogenates in a sterile solution of sucrose and 0.001 M EDTA were centrifuged and the heavy mitochondrial fraction was separated from the light fraction. The polarographic behavior before and after irradiation with a ^{60}Co source was determined. Some of the results showed a remarkable difference between the proteins of different organs. The proteins of the heavy mitochondria, under the effect of ionizing radiation, tended towards molecular association whereas those of light mitochondria tended towards disruption. (J.S.R.)

41149 THE MECHANISM OF BIOLOGICAL X-RAY ACTION. Otto Warburg (Max-Planck-Institut für Zellphysiologie, Berlin). Naturwissenschaften, 51: 373-6 (1964).

X rays act in living cells by two oxidants, hydrogen peroxide and OH radicals, that arise by the splitting of water and are measured by the oxidation of iron of the Fricke solution, in a manometric actinometer. The detector of the hydrogen peroxide is the enzyme catalase, added during the irradiation to the cell suspensions. All the oxidant that is not hydrogen peroxide, is the OH radical. No other substances are produced primarily by the x rays, because the absorbed energy of the x rays can be measured quantitatively by the oxidation of the iron of the Fricke solution. The two oxidants, hydrogen peroxide and OH radicals, may oxidize every component of the living cell. But the main substrates are the respiratory enzymes, the fermentation enzymes, and the protein synthesizing enzymes. (auth)

41150 ACTINOMYCIN AND RADIATION TREATMENT OF SACCHAROMYCES. E.-R. Lochmann and W. Stein (Freie Universität, Berlin). Naturwissenschaften, 51: 386-7(1964). (In German)

Yeast cells were exposed for 5 to 300 min in a phosphate buffer to actinomycin treatment. A very high actinomycin concentration was necessary to achieve a visible inactivation. The influence of actinomycin on growth was determined by turbidity measurements. The combined effects of radiation and actinomycin were studied with ultraviolet and x radiation. The combined treatment decreased sharply the survival times of the yeast cells. (M.C.G.)

41151 PERMEABILITY OF THE INTESTINAL WALL TO POLYVINYLPYRROLIDONE-I^{131} IN PATIENTS SUBMITTED TO ABDOMINAL-PELVIC IRRADIATION. L. Dalla Palma, R. Masi, and L. Cionini (Università, Florence). Nuntius Radiol., 29: 531-41(1963).

The results are presented of a study on the behavior of the permeability of the intestinal walls to polyvinylpyrrolidone-^{131}I. The research was carried out in patients who were irradiated over the abdominal pelvic area as part of a wider exploration of the radiobiology of the human intestine. Results indicate that therapeutic irradiation does not bring about variations in the permeability of the intestine to macromolecules. These differences appear to be due to the lesser seriousness of the intestinal lesions observed in the clinical field, as against those that are provoked in the experimental animal. It is thus possible to exclude the existence of loss of proteins through the intestine during therapeutic irradiation of the abdominal pelvic area. (Excerpta Med., Sect. XXIII, 1: (Aug. 1964))

41152 INTESTINAL Fe^{59} UPTAKE FOLLOWING ABDOMINAL-PELVIC IRRADIATION. L. Dalla Palma, L. Cionini, and A. Miliani (Università, Florence). Nuntius Radiol., 29: 597-610(1963).

Intestinal absorption of ^{59}Fe was studied in 18 patients therapeutically irradiated in the abdominal pelvic region. In the same patients, in order to estimate the avidity of the tissues for the metal, simultaneous determination was carried out of the half-life ($T^1/_2$) in plasma of a dose of ^{59}Fe injected intravenously. Statistical analysis of the results showed an average behavior characterized by reduced intestinal absorption and prolongation of $T^1/_2$ of ^{59}Fe half-time through the treatment cycle and a rise of absorption and shortening of $T^1/_2$ at its end. The cause of the observed phenomena would lie either in a change of the intestinal wall which became thinner in the second part of the treatment or in an alteration of the erythropoietic activity in the course of irradiation. (Excerpta Med., Sect. XXIII, 1: (Aug. 1964))

41153 INCIDENCE OF MALIGNANT TUMOR OF THE PELVIC ORGANS IN PATIENTS PREVIOUSLY IRRADIATED FOR BENIGN GYNECOLOGIC LESIONS. A. Corinaldesi and C. Rimondi (Università, Bologna). Panminerva Med., 6: 165-70(May 1964).

A survey was made of 398 patients subjected to pelvic irradiation in the Bologna Radium Institute, between 1935 and 1957, for benign gynecologic diseases. The patients treated in the last four years are not included as the interval between irradiation and examination is too short. The patients ranged from 25 to 60 years of age, over 83% being past 40 years of age. With regard to method of radiation therapy, 81% were subjected to x-ray therapy, 5% to Ra application, and 14% to combined therapy. X-ray treatment was generally carried out over two fields a day, each with a surface dose of 200 to 300 R; total dose fluctuated between 2800 and 7000 R. Intracavity Ra therapy was carried out with two 10-mg Ra tubes. Of the 398 patients who underwent radiation treatment up to 1957, at the time of the last follow-up 49 were found to have died, the majority from cardiovascular diseases, some from inflammatory diseases of the respiratory system, and 7 from malignant tumor of the pelvic organs (uterus, cecum, and sigmoid). Case reports including the medical history and clinical and operative findings of the patients previously irradiated who died from malignant tumor are described. Tumors occurred more frequently in women who survived longest after irradiation. It is concluded that the number of women who died from tumors following radiation therapy is too small to allow significant conclusions to be drawn from comparison with mortality statistics for control populations. The percentage of women over 50 yr of age who died from malignant tumor of the regions considered in the present investigation is 14% for this series and 25% for the control group, which suggests a smaller incidence of malignant tumor in this series than in the control group. Further analysis of the findings do not show significant differences in the incidence of tumors between women who died following radiation therapy and those who had never been irradiated, both with regard to general and individual tumor sites. (BBB)

41154 MORPHOLOGIC AND SOME BIOCHEMICAL CHANGES IN THE ADRENAL GLANDS IN ACUTE RADIATION DISEASE IN RATS. J. W. Borowicz and W. Bicz (Inst. of Experimental Pathology, Warsaw). Patol. Polska, 14: 227-35(Apr.-June 1963). (In Polish)

Adult male Wistar rats were subjected to 900-R, whole-body x irradiation, and the adrenals were examined histologically and histochemically six hr to eight days later. Macroscopic changes were not visible. During the first 24-hr period after irradiation, small hyaline thrombi were seen in the blood vessels and subsequently increased in size, though not leading to the occlusion of the vessel. No necrotic changes or blood extravasation described by others were found. Beginning from the 6th day, cells of the reticular layer in the cortex showed vacuolar degeneration. On the 6th and 8th day cellular atrophy occurred in the adrenal medulla. Investigations of the distribution of ascorbic acid showed that, in control animals, it occurs abundantly in the cells of the layers of the adrenal cortex. In animals killed during the first 24 hr after irradiation ascorbic acid was also found in the cortical layers but little in the cellular cytoplasm. Later, both the distribution and quantity of ascorbic acid were similar in both experimental and control animals. Staining for lipids using Sudan III and red oil O showed the greatest accumulations of these substances in the zona glomerulosa and in the upper half of the zona fasciculata, and the reaction was similar in irradiated animals with the difference that after the third day the staining was much less intense. Phospholipids had a similar distribution in the control animals to that described for other lipids, and irradiated animals killed during the first few days showed very little difference from the picture in control animals; on the 6th and 8th day, the intensity of the reaction was considerably reduced and in some animals even completely absent. Staining with Nile blue to detect the presence of neutral and acid lipids showed that in the first 24 hr after irradiation, acid lipids appeared, particularly in the zona fasciculata; later in the experiment (3rd, 6th, 8th day) the situation was the same as in control animals, with almost only neutral lipids being present. Six hr after irradiation, sterol content in the adrenals was considerably decreased compared with control values. During the subsequent days, the quantity of sterols slowly increased, reaching a normal level on the 6th day and a value higher than in the control on the 8th day. The appearance of free fatty acids during the first 24 hr after irradiation suggests major disturbances in lipid transformation. (BBB)

41155 QUANTITATIVE PIGMENT INVESTIGATIONS IN RADIATION-INDUCED CHLOROPHYLL MUTANTS OF *PISUM SATIVUM*. I. THE LETHAL MUTANTS. W. Gottschalk and F. Mueller (Universität, Bonn). Planta, 61: 259-82(1964). (In German)

The coloring materials involved in assimilation for 26 x-ray-induced lethal mutants of *P. sativum* were analyzed. The genetically determined width of variation, based on fresh wt, had the range 0 to 141% of total chlorophyll compared with that of starting material. The carotenoids ranged from 8 to 141%. The ratio of chlorophyll a to b ranged from 0.1 to 5.1. In some mutants a negative assimilation balance was found in the Warburg apparatus. Therefore the chlorophyll present could not be used for assimilation because of a mutated gene. In some mutants chlorophyll formation was light- and temperature-dependent. At temperatures below 18°C mutant 159 forms chlorophyll; below, it does not. In darkness, in mutant 11A the higher leaves produces chlorophyll; chlorophyll is retained when the synthesis itself stops in both mutants. The relation between lethality and chlorophyll defect is discussed and it is concluded that in most cases, the chlorophyll defect was not the sole cause of lethality. (TCO)

41156 A CONTRIBUTION ON THE COMBINED ACTION OF SiO_2 AND ALPHA RADIATION IN ANIMAL EXPERIMENTS. Josef Sevc and Rudolf Karasek. Pracovni Lekar., 16: 268-72(1964). (In Czech.)

The combined effect of SiO_2 (cristobalit) and alpha-radiation (plutonium nitrate) was investigated in experiments with female white mice. The use of the model of hepatic silicosis with intravenous introduction of the noxa facilitated exact and reproducible experiments. The degree of liver fibrosis was evaluated quantitatively by the biochemical determination of hydroxyproline and histologically. Under the given experimental conditions SiO_2 was shown to have a low fibroplastic action in the presence of long-term alpha-radiation which was displayed by a decrease in the absolute amount of hydroxyproline and in the number of reticulin and procollagenous fibres. (auth)

41157 RELATIVE CYTOGENETIC EFFICIENCY OF MUONS AND π^- MESONS IN *ZEA MAYS* (L.). Alexander Micke, Harold H. Smith, Robert G. Woodley, and Alfred Mashke (Brookhaven National Lab., Upton, N. Y.). Proc. Natl. Acad. Sci. U. S., 52: 219-21(Aug. 1964). (BNL-7764)

Dormant seeds of a stock of *Zea mays* (L.), heterozygous for the yellow-green Yg_2/yg_2 alleles, were irradiated with beams of mesons (μ^-) and mesons (π^-). The efficiency of mesons (μ^-) in producing yellow-green sectors in the seedling leaves was ~0.8 compared to 250-kvp x rays, while the relative efficiency of mesons (π^-) was about 3.4. (auth)

41158 RADIATION-INDUCED LEUKEMIA IN GERMFREE MICE. Morris Pollard and T. Matsuzawa (Univ. of Notre Dame, Ind.). Proc. Soc. Exptl. Biol. Med., 116: 967-71(Aug.-Sept. 1964).

Lymphatic leukemia was elicited by whole-body x-irradiation in germfree mice of Swiss-Webster, C3H, and C57 Bl strains. The disease was not observed in untreated germfree control animals. The leukemic lesions resembled those induced by x-irradiation in conventional counterpart animals. Cytoplasmic viral inclusions were noted by electron microscopy in cells from the enlarged thymus glands. In analyzing the technical details whereby the animals were entered into and maintained under germfree conditions, one can conclude that the occult leukemogenic agent was perpetuated in successive generations of mice by vertical passage, through the ovum or through the placenta. (auth)

41159 TOXICITY OF HIGH LEVELS OF CALCIUM-45, STRONTIUM-90 AND PROMETHIUM-147 TO AVIAN EMBRYOS. F. R. Mraz, P. L. Wright, and T. M. Ferguson (Univ. of Tennessee, Oak Ridge). Proc. Soc. Exptl. Biol. Med., 116: 1114-18(Aug.-Sept. 1964).

As low as 100 μc ^{45}Ca administered either at four or eight days of incubation produced broken or fractured bones in chicken embryos. This same level of ^{90}Sr-^{90}Y was less effective than ^{45}Ca producing these fractures when administered at eight days of incubation. The changes produced by ^{45}Ca injected at 14 days of incubation, ^{90}Sr-^{90}Y at 4 and 14 days and ^{147}Pm injected at 4, 8 and 14 days were developmental abnormalities frequently produced with external irradiation. (auth)

41160 OXIDATIVE PHOSPHORYLATION AS A PHOTOMORPHOGENIC CONTROL. Solon A. Gordon (Argonne National Lab., Ill.). Quart. Rev. Biol., 39: 19-34(Mar. 1964).

The hypothesis that high-energy phosphate is a morphogenic determinant flowing through the phytochrome valve in the response of plants to red light (~660 mμ) and far-red light (~730 mμ) is discussed. Previous studies on the enhancement of x-ray-induced chromosome damage by non-ionizing radiation energy are reviewed. The effect of red and far-red light on the ability of the mitochondrion to generate adenosine triphosphate was studied when the various ingredients required for esterification were nonlimiting. Oat seedlings previously exposed to far-red light yielded mitochondria with lower phosphorylation rates than those from nonirradiated controls. On the other hand, exposure to red light increased the esterification rate. The response to light was not observed when mitochondria isolated from dark-grown oat seedling were irradiated *in vitro*. Red light enhanced the phosphorylation activity of mitochondria from the livers of 2-month-old rats, while far-red light inhibited it. The action of the far-red light in inhibiting phosphorylative activity could be reversed by red light. Data suggested that the response of the mitochondria to the red spectral region might be related to a phytochrome component of the organelle. The uptake and esterification of inorganic phosphate were quickly activated in lettuce seed by the same spectral region (red light) that induces germination. Far-red light, however, frequently depressed phosphate exchange below the levels of controls kept in the dark. The effects of one spectral band were repeatedly reversible by the other. The effect of far-red light in potentiating the damage caused by x radiation to tumor-cell chromosomes can be correlated with a decreased ability of the cells to esterify. (M.C.G.)

41161 RADIATION INJURIES OF THE CERVICAL SPINAL CORD FOLLOWING THERAPEUTICAL IRRADIATION OF MALIGNOMA. F. Held, W. Panther, and

P. Schroeter (Universität, Rostock, Ger.). Radiobiol. Radiotherap., 5: 419-28(1964). (In German)

After a discussion of the so far rare communications about radiation injuries of the spinal cord in radiological literature, publications in neuropathological-anatomical journals are discussed in detail. From two examples, the possibility of radiation injury of the cervical spinal cord by x-ray therapeutical measures in the cervical region is reported. In order to confirm the theoretically calculated tumor dose several measurements with dead bodies using x-rays under clinical conditions took place. The occurring injuries and measured doses led to the conclusion to be more careful with x-irradiation of the cervical spinal cord with conventional deep therapy and to consider radiation injuries in the developing symptoms. (auth)

41162 THE EXPOSURE OF THE CERVICAL SPINAL CORD IN RADIATION THERAPY OF LARYNGEAL CARCINOMA. K. Bettenhaeuser (Rontgen- und Radiuminstitut der Medizinischen Akademie, Erfurt, Ger.). Radiobiol. Radiotherap., 5: 429-34(1964). (In German)

The dosimetry of radiation therapy in the area of the cervical spinal cord in the stationary-field and convergent-beam irradiation of the larynx is reported. The use of greater fields in the stationary-field irradiation results in relatively high radiation doses. The lowest exposure is achieved in the convergent-beam irradiation. Especially for circumscript small laryngeal tumors the stationary-field irradiation with the convergence apparatus and the 5 cm circular cone proved favorable as there is a relatively low exposure of the cervical spinal cord. (auth)

41163 COMPARATIVE INVESTIGATIONS OF THE EFFECTS OF PROLONGED IRRADIATION IN EXPONENTIALLY DECREASING DOSES. H. Kapp-Schwoerer (Universitats-Frauenklinik, Freiburg i. B.). Radiobiol. Radiotherap., 5: 469-76(1964). (In German)

Clinical experience and dosage studies necessitated by the intratumoral application of radiogold seeds (Au 198 as a closed gamma emitter) have prompted detailed investigations of the different effects of prolonged irradiation in exponentially decreasing doses as compared with conventional fractionated x-ray therapy or radium application. To achieve epilation in rabbits, it was necessary to deliver a dose of prolonged irradiation with radiogold seeds which was four times as high as that of a single short-distance irradiation and approx. twice as high as that of a fractionated irradiation. Studying growth and mitosis in Vicia faba, it was observed that in a higher dosage range prolonged irradiation with exponentially decreasing radiogold seeds caused a greater damage (inhibition of mitosis) than x-ray therapy or an equal dose of radium delivered within four days. On the other hand, it was observed that in a lower dosage range the radiation effects acted in the reverse order. (auth)

41164 THE OXYGEN EFFECT IN THE IRRADIATION OF DNA. Ya. L. Shekhtman, I. D. Vinogradova, and E. V. Moiseenko (Inst. of Biology and Physics, Moscow). Radiobiologiya, 4: 473-5(1964). (In Russian)

The question whether there is a primary substratum in the radiation injury of the cell is one of the most urgent problems of radiobiology. In view of the contradictory results obtained by various authors on the effect of O in the internal and external irradiation of DNA, this problem was further investigated by examining the results of the exposure of live cells and of the DNA of the same cells to radiation. Fish sperms in physiological solution were irradiated in air and in Ar containing less than 0.003% O. The irradiated sperms were used for the examination of the effect on DNA on the basis of viscosity measurements and for impregnation tests, determining the survival rate of the offspring and the number of malformations. A dose of 1500 R in air resulted in 100% survival; without the presence of O, this dose was 2000 R, yielding an O effect of 1.33. A complete agreement was noted between the O effect on the survival rate and the structural changes of the DNA removed from the same irradiated sperm. It is concluded that the protective action of O, reported by P. Aleksandrev and Z. Bak (Primary and Initial Processes of the Biological Action of Radiation, 1963), involving the formation of joints in the DNA under the influence of radiation, is not sufficient to counteract the harmful role of DNA in radiation injury. (TTT)

41165 THE EFFECT OF IONIZING RADIATION ON THE DURATION OF MITOSIS IN THE EPITHELIUM OF THE CORNEA OF THE MOUSE. A. D. Strzhizhovskii. Radiobiologiya, 4: 476-81(1964). (In Russian)

The duration of the mitosis of normal and irradiated cells must be known in order to be able to interpret the effect of radiation on the multiplication of cells. The method based on the blocking of the start of the mitosis of the cells was used for this study. The cornea of white mice was exposed locally to soft x radiation, and test and control animals were killed at various periods after irradiation. A count was made of mitosis per 10^4 cells, together with the chromosome aberrations, and the start of the anaphase. In the first series the mice were exposed to 100, 700, 2760, and 10,000 R, killed at 15, 30, 45, 60, and 70 minutes after the irradiation. In the second series, aimed at the determination of the average duration of mitosis, groups of animals were exposed first to 700 R; 3 days later half of them were again irradiated at 100 R and the rest at 500 R. Another group was first exposed to 2760 R and 6 days later to 100 R, and the animals killed at various periods after irradiation. The results revealed that there is a latent period between the irradiation and the start of the blocking effect; this period decreases with increasing dose. The duration of the mitosis in the epithelium of the cornea was found to be 21 ± 1.2 min. Exposure to a dose of 2760 R did not affect directly the mitosis; a dose of 10,000 R caused an increase of the average duration to 36 ± 2.2 min. Exposure to a dose of 700 R of the cells in interphase did not affect the course of the subsequent mitosis. Injury to the genetic structure of the cells, as shown by chromosome aberrations, did not affect the rate of the mitosis. (TTT)

41166 THE OXYGEN EFFECT IN THE CASE OF THE IRRADIATION OF HUMAN ERYTHROCYTES BY γ RADIATION AND THE ACTION OF OLEIC ACID ON THEM. N. P. Korolev (Moscow State Univ.). Radiobiologiya, 4: 482-6 (1964). (In Russian)

Oxidative chain processes in biolipids formed in the tissues of irradiated organisms play an important role in the development of radiation injury. It was proposed by G. I. Gasanov and Yu. B. Kudryashov (Doklady Akad. Nauk SSSR 144, 443 (1962) No. 2) that the oxidation products of unsaturated fatty acids may participate in these reactions. The O effect was studied in human erythrocytes exposed to γ radiation, and the effect of oxidized and unoxidized oleic acid on them was determined. The erythrocytes were separated from the blood by centrifugation; the irradiation was carried out in air or under N_2, at a dose rate of 1800 R/min in physiological solution. The effect of oleic acid was studied with the help of an emulsion, the concentration of which was so chosen that the hemolysis of the erythrocytes was completed in about 15 minutes. A definite O effect was noted both in the case of exposure to γ radiation and to oxidized oleic acid; the unoxidized acid does not exhibit such an effect. It is concluded that the O effect is due to the destruction of peroxides of the fatty acids by the hemoglobin, thereby disturbing the osmotic equilibrium with the medium. (TTT)

41167 OXIDATIVE PROPERTIES OF ANIMAL TISSUES IN THE CASE OF RADIATION INJURY. A. S. Mochalina and L. L. Khamaide. Radiobiologiya, 4: 487-92 (1964). (In Russian)

The dynamics of the changes in the oxidative properties of animal tissues exposed to ionizing radiation while being protected by chemical methods, were investigated by using a method based on the oxidation of the leuco base of thionine. The white mice used for the test were divided in 3 groups, including a control group, one exposed to 700 R of γ radiation at the rate of 296 R/min, while the third, similarly irradiated group was prophylactically protected by means of an intraperitoneal injection with β-amino ethyl thiosulfate 5 minutes prior to irradiation. This compound possesses properties similar to that of β-mercapto ethylamine. The liver, brain, and spleen of the animals killed within a specified period after the irradiation, were used to determine the oxidative activity by means of the leuco base of thionine. It was found that the extracts from the organs of the healthy animals had only a very low-level oxidative activity, mostly noticeable in the brain. The irradiation resulted in the increase of this activity within a period of 1 hour after exposure, remaining at that high level for several days. Injection of the protective compound again lowered the oxidative activity but it was still higher than that of the control animals. (TTT)

41168 VARIOUS STAGES OF THE INHIBITION OF OXIDATIVE PROCESSES BY TISSUE LIPIDS. Yu. N. Filippov. Radiobiologiya, 4: 493-7(1964). (In Russian)

The presence of bio-antioxidants, such as phospholipids, tocopherol, etc., in the tissue fats is responsible for their high antioxidative activity and possible also for the prevention of lethal effects upon exposure to low-level radiation. In order to understand better the mechanism involved, the inhibition of oxidative processes by the tissue lipids was studied at various stages of the oxidation process, using tissue fats from the brain of the dog which possess high antioxidative activity and are also stable against peroxides. The free lipids were extracted in a Soxhlet apparatus and were kept in darkness at 4°C in closed containers under penicillin. Oleic acid, with an initial peroxide number of less than 20 milliequiv./g, was used for obtaining the peroxides. The acid was oxidized by atmospheric O in the dark at an incubation temperature of 40°C, and the peroxide content determined by iodometric titration, while the antioxidative property was derived from the difference of the peroxide numbers of the pure oleic acid and of the same acid containing added fatty material. The tissue lipids were added before the incubation and the peroxide number was determined after 5, 24, 48, and 72 hours. The results indicated that the dog's brain contains a neutral protective material which inactivates the radicals and peroxides formed during the oxidation of fats. The successive stages could be noted during the 72-hour long oxidation of the oleic acid; the promoters of these stages were found to possess a varying sensitivity toward the action of the natural inhibitors. These findings are important for clarifying the mechanism of natural radioprotective agents during the primary interaction of radiation with matter. (TTT)

41169 THE DNA CONTENT AND ITS BIOSYNTHESIS IN THE TISSUES OF THE MOUSE IN CASE OF REPEATED EXPOSURE TO X RADIATION. A. S. Orlov and E. I. Orlova (Inst. of Radiation Hygiene, Leningrad and Inst. of Medical Radiology, Leningrad). Radiobiologiya, 4: 498-502(1964). (In Russian)

It has been shown repeatedly that exposure of animals to sublethal doses of ionizing radiation causes increased resistance against radiation a certain time later. Believing that DNA plays an important role in this process, the concentration of this compound and the course of its synthesis in the tissue of mice which were previously exposed to a dose of 25 R x radiation were examined. Even though this dose does not cause any marked morphological changes, it has a protective effect. The animals were exposed to a lethal dose of 1000 R 14 days after the first irradiation, and killed 2, 4, or 8 hours after the second exposure. Prior to that, 0.1 ml of a $NaH_2{}^{32}PO_4$ solution, with an activity of 100 μcurie/ml, was injected hypodermically. The spleen and the small intestines were used for the study. It was found that up to the time of the second irradiation, the various indexes of the animals subjected to a first, low-level irradiation were close to the normal level. The DNA content in the small intestines of the pre-irradiated animals was found to be more stable during the first hours after the second exposure than that of the animals exposed only to the lethal dose. The concentration and the biosynthesis of DNA in the animals 8 hours after the second irradiation were found to be at a lower level than in the corresponding group irradiated only once. The preliminary irradiation did not appear to have affected the DNA concentration in the spleen during the first hours after the second exposure. (TTT)

41170 THE METABOLISM OF RIBONUCLEOTIDES IN THE BONE MARROW OF IRRADIATED RABBITS. R. E. Libinzon and I. A. Tseveleva. Radiobiologiya, 4: 503-7(1964). (In Russian)

The inhibition of the synthesis and the lowering of the concentration of nucleic acids in the bone marrow is one of the most common effects of ionizing radiation in the mammalian organism. Its mechanism was investigated by determining the concentration of various mono- and polyphosphates of nucleosides at various periods after irradiation. The rabbits used for the experiments were exposed to a dose of 1000 R of γ radiation from a ^{60}Co source at a rate of 10 R/min after the injection of an $Na_2H^{32}PO_4$ solution at 30 μcurie/kg body weight. The animals were killed 30 to 60 minutes, 4, 12, 24, and 48 hours after the irradiation. No marked changes were found in the concentration of the nucleotides during the first 4 hours after the exposure; however, 48 hours later, the concentration and the rate of phosphorylation of the ribonucleoside mono- and polyphosphates were strongly affected. Changes could be detected within 12 hours. The RN polyphosphate concentration was lowered while that of certain monophosphates was increased. Within 24 hours after exposure, the concentration of nucleotides at all phosphorylation levels was either normal or slightly increased. The incorporation of the radioactive P did not vary much at the start; 4 hours after irradiation the phosphorylation of mono-, di- and triphosphates was found to be depressed; during the 12 to 24 hour period, a regeneration of this process was noted. It is concluded that the inhibition of the synthesis of RNA in the bone marrow after massive irradiation is not due to an insufficiency in the precursors of the phosphorylation reaction. (TTT)

41171 THE ROLE OF DIOXYPHENOLS IN THE MECHANISM INVOLVED IN THE ACTION OF γ RADIATION ON PLANTS. V. A. Kopylov and A. M. Kuzin (Inst.

of Biology and Physics, Moscow). Radiobiologiya, 4: 508-12(1964). (In Russian)

The authors previously pointed out the important role played by phenols and quinonoid compounds in the action of ionizing radiation on plants (Biofizika 5, 716 (1960); Radiobiologiya 1, 358 (1961)). It appears probable that during the irradiation of seeds, changes take place in the activity of the polyphenol oxidase reaction; therefore, even during the early stages of germination the amount of the dioxyphenol formed in the tissues should exhibit differences, when compared to the amounts found in normal tissues. Experiments were carried out with Vicia faba seeds to determine the validity of this assumption. The specimens were irradiated by a 0.7 curie/min γ source at total doses of 0.25, 0.5, 1.0, 2.5, and 5 kR. On the 15th day after the irradiation, the phenol content of the leaf samples was determined. The results indicated that irradiation of the V. faba seeds by doses from 2 to 5 kR causes disturbances in the phenol metabolism of the growing plants. After exposure to a dose of 0.5 kR, which stimulates the growth, the concentration of the orthophenols was increased and their absorption spectrum was changed; also, these compounds were secreted by the rootlets of the plant. Exposure to 5 kR, which suppresses the growth, resulted in the decrease of the orthophenol concentration and in a marked increase of melanin in the root, indicating the strong effect of the oxidation and condensation processes under these conditions. It is concluded that the radiation-induced changes in the isoenzyme structure of the polyphenol oxidase are primarily responsible for the observed damaging effect. (TTT)

41172 DISTURBANCE IN THE BLOOD PROTEOLYSIS IN DOGS AFTER EXPOSURE TO IONIZING RADIATION. Yu. P. Druzhinin and V. N. Benevolenskii. Radiobiologiya, 4: 513-15(1964). (In Russian)

Radiation sickness usually causes the secretion of large amounts of albuminous decomposition products in the urine; at the same time the relative activity of the proteolytic ferments is increased and the decomposition of the irradiated tissues is accelerated during the in vitro autolysis. For diagnostic and therapeutic reasons, it is important to be able to correlate the catabolic processes with the radiation dose. Following up the authors' previous studies on the autolysis of blood in rats (Radiobiologiya 4, 384 (1964)), proteolysis was investigated in dogs, comparing the sensitivity with the reactions in other systems, such as the changes in the blood components. The dogs were exposed to doses of 300 and 500 R of γ radiation from a ^{60}Co source; blood samples were taken 1, 2, 3, 7, 12, 20, and 30 days after the irradiation, and both whole blood and plasma were examined. The level of proteolysis was determined by incubation at 37°C for 6 hours after addition of thymol. It was found that during the first days after irradiation, proteolysis of the blood is markedly lowered; this is followed by a rise during the first 7 days. Between 20 to 30 days after irradiation the plasma exhibited a similar, although less marked, behavior. The dynamics of the proteolysis of the blood of the irradiated animals did not follow the changes in the concentration of the leukocytes and erythrocytes. (TTT)

41173 SOME OBSERVATIONS ON THE INFLUENCE OF OXYGEN ON THE RADIATION EFFECTS ON RATS. L. S. Isupova and V. G. Yakovlev. Radiobiologiya, 4: 516-20(1964). (In Russian)

In order to determine whether the radiation resistance of organisms involves quantitative changes in the metabolism in the various organs and tissues, reflecting the effect of O, experiments were carried out on tissues from male rats, kept in continuously regenerated medium, such as air, O_2, N_2, or a mixture of the last two gases, at a pressure of 1 atmosphere. It was expected that the results will clarify the influence of the inhaled O on the natural, nonalbuminous sulfhydryl groups in the radiation-sensitive organs and tissues, and in animals treated with protective agents, such as cysteine. The animals were previously exposed to a dose of 750 R of γ radiation. The results indicated that the effect of inhaled O on the development of the radiation sickness is only moderate; under the test conditions employed, the O effect is not a major factor in the enhancement of the consequences of the whole-body irradiation. The marked changes in the radiosensibilizing effect of O at higher pressures, reported in the literature, must be ascribed to supplementary activity in the physiology of the test animals. (TTT)

41174 CHARACTERISTICS OF THE REGULATION OF THE VENOUS BLOOD CIRCULATION IN THE HYPOTHALAMIC AREA IN IRRADIATED ANIMALS. N. P. Smirnova and V. M. Volodin. Radiobiologiya, 4: 521-7(1964). (In Russian)

Electrocardiograms of irradiated animals often indicate disturbances in the arterial blood circulation. The problem was extended by investigating the central autonomic regulation of the venous blood flow on the basis of the effects of the irritation of the hypothalamic area on the coronary blood vessels. The experiments involved the comparative study of threshold and higher-level irritation due to the introduction of pituitrin, hexonium, and aminasine, and irritation of the frontal hypothalamic area of cats by a sinusoidal current from a 100-herz generator through a steel electrode for a period of 30 seconds. The tests were carried out at various intervals after exposing the animals to 500 R of x radiation. It was found that irradiation induced changes in the reaction of the venous blood vessels after exposure of the hypothalamic region. The first reaction, observed 1 day after the irradiation, consisted in the reduction of the number and the magnitude of the vasoconstrictive responses and an increase of the two-phase and vasodilation reactions. After 4 days, the irritation threshold of the hypothalamus with respect to the venous blood vessels is lowered. The course of the blood pressure changes was quite similar. The results obtained with pituitrin, hexonium, and aminasine indicate that these changes are due to disturbances in the neuro-endocrinal regulation at the hypothalamus–hypophysis level. (TTT)

41175 CHANGES IN THE COURSE OF CORASOL-TYPE CONVULSIONS INDUCED BY WHOLE-BODY EXPOSURE TO X RADIATION AT VARIOUS DOSES. T. M. Kucherenko (Pavlov Inst. of Physiology, Leningrad). Radiobiologiya, 4: 528-30(1964). (In Russian)

The author found previously (Radiobiologiya 3, 71(1963)) that the rate and the intensity of corasolum-induced convulsions in rats after irradiation are markedly increased during the first hours, pointing to the possibility that the increased excitability of the central nervous system may be revealed by means of the convulsion test. The current series of experiments were designed to uncover the relation between the radiation dose, the degree of convulsive reaction, and functional changes of the brain. Female white rats were subjected to single doses of 100, 210, 420, 750, 1000, 1500, 2000, and 5400 R x radiation, before drug injection. The convulsive reaction was estimated during the 60 minutes after the injection on the basis of the latent period and of the convulsive reaction. The results indicated that excitability changes may be noted after whole-body irradiation at doses of 420 R or higher. The threshold of the appearance of functional changes in the brain agrees with the threshold dose. Higher doses do not cause further increase in the excitability of the central nervous system, indicating that this effect is due to a remote, rather than to a direct effect of the radiation. This finding is in agreement with studies on the phospholipid metabolism of the brain. (TTT)

41176 COMPARATIVE PHYSIOLOGICAL STUDY OF THE FUNCTIONAL STATE OF THE VAGUS NERVE CENTERS UNDER THE INFLUENCE OF IONIZING RADIATION. Ming-hua Chang (Inst. of Experimental Medicine, Leningrad). Radiobiologiya, 4: 531-5(1964). (In Russian)

Changes in the autonomic nervous system following exposure to ionizing radiation may result in disturbances in the neuro-humoral regulation of the organs and tissues. This problem was studied by examining the effect of radiation on the functional state of the vagus nerve of animals, such as rabbits, cats, and dogs, not subjected to narcosis, and differing in their parasympathetic effects on the heart. The atropine test was used to determine the tonus of the vagus nerve; an electrocardiograph was employed to record the pulse rate and the respiration rate. The animals were exposed to a single dose of x radiation of 1000 R for rabbits, 550 R for cats, and 600 R for dogs. It was found that during the first days after exposure to these doses, causing acute radiation sickness, the tonus of the vagus nerve of the animals was increased by varying amounts, depending on the animals, as judged by the atropine test. Only in the case of rabbits was there a marked immediate increase after exposure. Later, as the radiation sickness followed its course, all animals exhibited a lowering of the nerve tonus. The excitability of the vagus nerve centers of rabbits was lowered immediately after exposure; during the later periods, it became higher than before irradiation. The tonic activity and the excitability of rabbits during the first period of the radiation sickness underwent dissimilar changes: as the tonus increased, the activity of the heart was lowered. (TTT)

41177 THE PROBLEM OF THE RELATION OF THE VEGETATIVE CENTERS OF THE CEREBELLUM WITH THE REACTION INVOLVING THE EFFECTS OF IONIZING RADIATION. N. P. Smirnova. Radiobiologiya, 4: 536-40(1964). (In Russian)

Studies of the regulatory functions of the cerebellum in the case of exposure of the organism to radiation, have been carried out in the past by means of irritation tests carried out with unipolar or bipolar electrodes. The skin potentials were transferred to an electrocardiograph which recorded the irritation effects as soon as they occurred. In order to further investigate this problem, cats were irradiated at a total dose of 600 R of x radiation. The functional state of the autonomic centers was estimated on the basis of the excitability of the sympathetic centers of the cerebellum. As expected, the results did reveal phase changes in excitability. During the first days and at the height of the radiation sickness a lowering of the excitability was noted, followed by an increase before and during the terminal stages. After cutting through the middle brain the original reaction of the sympathetic centers of the cerebellum to radiation was completely eliminated. (TTT)

41178 THE ROLE OF VARIOUS ORGANS IN THE SYNTHESIS OF ANTIBODIES IN THE CASE OF THE EXPOSURE OF THE ORGANISM TO IONIZING RADIATION. L. G. Prokopenko (Kursk Medical Inst., USSR). Radiobiologiya, 4: 541-3(1964). (In Russian)

The activity of individual organs involved in the synthesis of antibodies and their participation in immunological reactions in the case of radiation injury, associated with the depression of lymphatic functions, was studied during the first stages of the development of the immunity in healthy and irradiated animals. An attempt was made to clarify the importance of the various physico-chemical factors for immunogenesis in the individual organs. Rabbits were exposed to 1000 R of γ radiation, then were repeatedly immunized with Bacterium paratyphi B vaccine and with human blood albumins. In a second series, after irradiation, the animals were immunized with Bacterium paracoli and human blood albumins adsorbed on the erythrocytes of the rabbit, after treating the latter with Cr chloride. The animals were killed 13 days after irradiation, i.e., during the period when the synthesis of the antibody due to the second injection of the antigen was at its height. The results indicated that the liver, the remote lymphatic nodes, and the spleen play an important role in the synthesis of antibody during the early stages of the development of the immunity in the case of radiation sickness. (TTT)

41179 DATA ON THE REPRODUCTION OF THE INFLUENZA VIRUS IN THE ORGANISM OF ANIMALS EXPOSED TO CHRONIC CONTINUOUS RADIATION. V. N. Sivertseva (Central Scientific Research Inst., Leningrad). Radiobiologiya, 4: 544-7(1964). (In Russian)

Use of ionizing radiation for the therapy of neoplasms and inflammatory processes requires the detailed knowledge of the chronic effects of radiation. The problem was studied by determining the influence of continuously applied radiation on the reproduction of the influenza virus in the lungs of white mice. The animals were exposed to 4.8 R/day γ radiation from a ^{60}Co source. During this period the leukocytes were systematically counted and weighed. After having exposed the animals to the desired dose, they were intranasally infected and the reproduction of the virus was determined. It was found that the continuous exposure to γ radiation enhanced the reproduction of the virus in the lungs of white mice. This observation is especially interesting for the total dose of 300 R because the author found earlier (Voprosy Radiobiologii, page 335, Vol. 3, 1960) that at that dose level the sensitivity toward staphyloccic infection is decreased, indicating a different behavior of the radiation toward antibacterial and antiviral immunity factors. (TTT)

41180 HEREDITARY CHANGES IN E. COLI CULTURES EXPOSED TO CONTINUOUS γ RADIATION. V. D. Zhestyanikov. Radiobiologiya, 4: 548-53(1964). (In Russian)

The author reported earlier that continuous exposure of certain E. coli cultures to γ radiation yields strains with increased radiation resistance; these strains also possess an S-shaped survival curve (Radiobiologiya 3, 847 (1963); 4, 96 (1964)). This problem was further examined by investigating the possible hereditary transmission of the acquired properties of the E. coli BγR, B/rγR, and K12γR strains, exposed to continuous radiation for periods ranging from 8 to 22 months. The dose-vs-survival curves were used as the indicator of the radiation resistance. It was found that the strains, previously irradiated for periods up to 22 months, after 5 to 13 transfers without radiation, exhibited a higher resistance than the original strain. The curve of the dose dependence of the survival of E. coli γR was found to be S-shaped; that of the other variants was exponential. The cells of the strains with the S-shaped curve had larger linear dimensions, larger volume and higher nucleoid content than the cells of the original strain.

The cells of the exponential variants contained the same amount of nucleoids as the cells of the original strain but were larger. It is assumed that the S-shaped variants of E. coli γR are diploid forms; however, it is possible, that the S-shape of the dose-vs-survival rate curve and the increased radiation resistance are due to an intensive post-irradiation regeneration process. (TTT)

41181 THE ACTION OF FAST NEUTRONS ON THE NUCLEUS DURING VARIOUS PHASES OF THE HUMAN CELL CYCLE IN A TISSUE CULTURE. N. P. Dubinin and N. P. Mokeeva (Inst. of Biology and Physics, Moscow). Radiobiologiya, 4: 554-62(1964). (In Russian)

Discovery of the varying sensitivity during different phases of the human cell cycle is related to the relative biological efficiency (RBE) of the various types of radiation. In this connection, the effect of fast neutrons on embryonic tissue cultures was investigated, using neutrons with energies ranging up to 12 Mev and an average energy of about 1.2 Mev. The source used yielded a mixed radiation of 73% neutrons and 27% γ radiation; the total dose was 50 rad, delivered at a dose rate of 5.4 rad/min. On the basis of the chromosome changes it was found that the RBE of fast neutrons equals or slightly exceeds (108%) that of x rays. Specific effects were observed during various stages. During the prophase, the neutrons up to 35 rad, had no effect. During the other stages examined, from 6 to 30 hours after the irradiation, the efficiency per 1 rad varied from 0.07% (12 hours after irradiation) to 0.4% (4 hours later). The breaks point to secondary processes, involving nucleus transformations. The neutron-induced breaks were found to differ from those caused by x or γ radiation. While the linear energy transmission effects of neutron and x radiations are similar, the reactions at various stages of the cell development cycle are different. (TTT)

41182 THE EFFECT OF VIBRATION AND OF X RADIATION ON THE CELL NUCLEUS OF THE BONE MARROW OF MAMMALS. Yu. S. Demin (Inst. of Biology and Physics, Moscow). Radiobiologiya, 4: 563-8(1964). (In Russian)

One of the chief problems of space biology is the study of the various factors acting on the living organism during the flight, such as weightlessness, radiation, acceleration, and vibration. Although the effects of radiation have been extensively studied, the behavior of cell nuclei subjected also to vibration is less known. The bone marrow cells of white mice were subjected to the simultaneous action of 100 R of x radiation and vibration at a frequency of 60 herz and an amplitude of 0.25 mm for 20 minutes. Cytological study after the test revealed that the vibration causes an increase in the frequency of the disturbances of the mitosis of the bone marrow cells; this effect lasted up to 10 days. The frequency was found to decrease when the animals were subjected to the combined effect of vibration and radiation. (TTT)

41183 ANALYSIS OF THE CAUSE OF THE ANOMALOUS DEPENDENCE OF THE MUTATION FREQUENCY IN DROSOPHILA SPERMATIDS ON THE IONIZING RADIATION DOSE. E. A. Abeleva (Inst. of Biology and Physics, Moscow). Radiobiologiya, 4: 569-74(1964). (In Russian)

Previous studies on the anomalous dependence of mutations on the radiation dose did not clarify the reason for the reduced efficiency of high-level doses. This problem was further investigated by assuming a differential radiation sensitivity of the cells at various stages of the spermatogenesis; the mutation and fertility curves of Drosophila males were compared after exposure to 1 and 3 kR of γ radiation. It was found that the dose of 1 kR does not cause deviation from the expected linear correlation but the relative biological efficiency of the higher dose was considerably reduced. Experiments with crossing-over, carried out with the Yellow Miller strain of Drosophila melanogaster, revealed that up to the 8th day after irradiation the male gametes produced a haploid chromosome set, thus indicating that the spermatogenesis occurred from the 4th to the 7th day after irradiation. On the 8th day meiotic division takes place; the 9th day is probably the period of growth of the later spermatogonia before the start of the meiosis. The mutability of the mature sperm, 1 to 3 days after irradiation, and of the growing spermatogonia at 1 kR were identical. The distribution of the mutability at the 2 dose levels agreed with the corresponding fertility curves. The data support the previously expressed assumption that the reduced relative biological efficiency of the high doses and the shift in the mutability of the spermatids are due to the death of the most genetically sensitive cells. (TTT)

41184 MORPHOLOGICAL CHANGES IN THE LIVER, SPLEEN, AND KIDNEY OF MICE SUFFERING FROM EHRLICH ASCITE CANCER, UNDER THE INFLUENCE OF INTRAPERITONEALLY INJECTED RADIOACTIVE COLLOIDAL GOLD. S. M. Volodarskaya (Sechenov First Medical Inst., Moscow). Radiobiologiya, 4: 575-7(1964). (In Russian)

It was shown previously that intraperitoneally injected radioactive colloidal Au is accumulated in the reticuloendothelial cells of the liver and the spleen; it is therefore of interest to examine the effect of extended radiation due to radioactive colloidal Au on these organs. The experiments were carried out with mice inoculated with Ehrlich ascite cancer. On the 3rd, 6th, and 10th day after the inoculation, colloidal Au solutions with an activity of 0.025 or 0.05 mcurie were injected in the animals. Sections of the spleen, liver, and kidney tissues were examined 1, 3, 5, and 10 days later. It was found that treatment with the radioactive Au solution caused dystrophic effects resulting in necrotic changes. The degree of the morphological effects depends on the state of development of the ascite cancer. Small variation in the blood could be observed in the spleen tissues. The lower dose, 0.025 mcurie, did not cause any visible morphological changes. (TTT)

41185 A METHOD FOR UNCOVERING EARLY INJURIES IN THE NUCLEAR STRUCTURE IN THE CASE OF WHOLE-BODY γ IRRADIATION. G. S. Kalendo (Inst. of Biology and Physics, Moscow). Radiobiologiya, 4: 578-81(1964). (In Russian)

Previous studies indicated that during the first days after irradiation the DNA is depolymerized and the link between DNA and DNP is weakened; the DNA is more easily separated in salt solutions secreted by irradiated animals. Using the method of salt fractionation of individual nuclei, the action of a 1 M NaCl solution on the thymus of the rat was examined in order to determine the effect of the rate of removal of nucleoproteins from the nucleus under normal conditions and after irradiation. The male white rats were exposed to γ radiation from a ^{60}Co source at a total dose of 1000 R, and were killed in 30 seconds, 15 minutes, and 6 hours later and the thymus treated with a 1 M NaCl solution. The results showed that the time since exposure affects markedly the cell structure. It is assumed that this is due to the degradation of the DNA in the DNP complex as the result of the irradiation. (TTT)

41186 CHANGES IN THE PROTEIN AND CARBOHYDRATE CONTENT OF PLANTS UPON IRRADIATION AT

VARIOUS STAGES OF ONTOGENY. R. S. Zhunusov. Radiobiologiya, 4: 599-602(1964). (In Russian)

Studies were undertaken to determine the changes induced in the biochemical composition of plants such as beans, peas, sugar beets, and potatoes by exposure to 400 R of γ radiation. The length of the stem, the number of leaves, the percentage of the dry material, the root yield of the beets and the tuber yield of the potatoes were measured at various stages of growth. The irradiation was carried out during sprouting, inflorescence, and budding. The results indicate that radiation does not affect the plant as a whole but it interacts with the process that is active during the irradiation. Thus, exposure during the period of budding when the protein is formed, results in an increase of the protein content of the grains; similarly, irradiation of potatoes at the time of the tuber formation causes an increase in the starch content. The protein content of the leguminous plants was also successfully increased by irradiating them during time of budding. Similar results were also obtained with sugar beets. It is concluded that by a suitable choice of the time of exposure to γ radiation, not only the ontogeny but also the biochemical processes may be controlled. (TTT)

41187 X-RAY SENSITIVITY OF THE GREEN AND COLORLESS CELLS OF EUGLENA GRACILIS KLEBS. V. G. Kasinova (Inst. of Cytology, Leningrad). Radiobiologiya, 4: 603-6(1964). (In Russian)

The ability of the chlorophyll-carrying Euglena gracilis to lose its chlorophyll and chloroplast renders it suitable for studying the effects of unfavorable factors on green and colorless cells of the Euglenoidinae; in this connection, the changes in the radiation sensitivity are of great importance. Therefore, the changes in the sensitivity of these cells toward x radiation were investigated. The colorless strain was obtained by the cultivation of the green variety in a medium containing streptomycin. Comparison of the two types revealed that the colorless cells are deprived of chlorophyll and chloroplast and are smaller than the green ones. The specimens were exposed to doses of 30.2, 60.4, 90.6, 120.8, 151 and 302 kR of x radiation, using the ability of the cells to survive as the criterion of their radiation sensitivity. The results indicated that the cells of the colorless strain are more sensitive toward exposure to x radiation; the mean lethal dose of soft x radiation was found to be 120 R for the green cells and 60 R for the colorless ones. The colorless cells also exhibited a greater sensitivity toward hydrogen peroxide. (TTT)

41188 EFFECT OF THE IRRADIATION OF SEEDS BY γ RAYS PRIOR TO SOWING ON THE ANATOMIC STRUCTURE OF THE PLANTS. P. A. Vlasyuk and V. V. Sil'chenko (Inst. of Plant Physiology, Academy of Sciences, Ukrainian SSR). Radiobiologiya, 4: 607-12(1964). (In Russian)

Treatment of various seeds with γ radiation before sowing could affect the yield and therefore this problem has been much investigated. However, the anatomic changes induced by the radiation are not sufficiently known and therefore such studies were carried out with the air-dried seeds of sugar beets and flax exposed to γ radiation in doses varying from 5 to 200 kR. The composition of the bound and unbound material was determined at the various stages of the growing period of the plants, with special attention to the palisade tissue of the leaves which are considered the most important tissue of the plant. As a result of the 3-year study, it was found that low-level irradiation of the seeds did not affect noticeably the anatomical structure of the plants; marked changes were noted only after exposure to high doses. Low-level exposure seems to stimulate the growth of the plants, resulting in an increase of the cell size and of the intracellular components. It is concluded that the anatomic structure of the plants is very stable with respect to ionizing radiation. The chief effect of the low doses was the thickening of the leaves caused by the increased size of the cells; the number of mesophyllic cells remained unchanged. The large doses caused definite injury to the plants, but the new growth exhibited a tendency to become normal. (TTT)

41189 RADIATION-RESISTANT FORMS OF THE DIPLOID AND AUTOTETRAPLOID BUCKWHEAT AND OF THEIR HYBRIDS WITH THE ORDINARY (2X AND 4X) BUCKWHEATS FROM THE POPULATIONS. R. N. Platonova and V. V. Sakharov (Inst. of Biology and Physics, Moscow). Radiobiologiya, 4: 613-18(1964). (In Russian)

Although the radiation-resistant forms of lower plants and simpler animals have been much investigated, there is only a paper by the authors (Radiobiologiya 2, 2(1962)) on the artificial enhancement of the hereditary traits of radiation resistance of higher plants by selection. In the above work it has been reported that both the diploid (2x–16 chromosome) and the tetraploid (4x–32 chromosome) forms of Fagopyrum esculentum Moenh exhibit higher stability toward γ radiation. This work was continued, determining the stability of the γ radiation resistant forms against fast neutron irradiation and studying the hereditary features of the 2x and 4x forms. Resistant and ordinary populations were irradiated by a dose equal to 400 R, including 305 R of fast neutrons and 95 rad of γ rays, in the biological beamhole of the IRT reactor. The absorbed dose was calculated on the basis of a 7% water content in the seeds. The survival rate and the chromosome aberrations due to the irradiation were determined. It was found that the γ–resistant forms are also resistant against fast neutron beams, as judged on the basis of the higher survival rate after exposure and the lower number of chromosome breaks in the first mitosis after germination. Hybrids of these (2x and 4x) forms with ordinary, previously not-irradiated buckwheat populations revealed the dominant character of the transmission of radiation-resistant features to the descendants. The hybrids showed the effects of heterosis. (TTT)

41190 THE POTENTIAL APPLICATION OF γ RADIATION FOR THE STERILIZATION OF CHLORIDEA OBSOLETA FOR THE PURPOSE OF REDUCING ITS POPULATION. S. V. Andreev, Z. I. Samoilova, and B. K. Martens (All-Union Inst. for Plant Protection, Leningrad). Radiobiologiya, 4: 624-6(1964). (In Russian)

Among the potential applications of ionizing radiation in biology and agriculture, its use in the fight against harmful insects is one of the most important. Sterilization of the males promises to become an economically valuable method. Experiments were carried out with the weevil Chloridea obsoleta, which causes considerable damage in cotton crops. A 550 R/minute ^{60}Co source was used to irradiate the male insects after cocoon stage at a total dose of 3 to 15 kR. The young caterpillars were fed with tomato plant leaves, the mature ones with ground seeds. The optimum temperature for the culture was found to lie between 23 and 25°C, at a relative air humidity of 65 to 70%. It was found that up to 8R, the life span and the fertility were not noticeably affected. The optimum dose for sterilizing the male for the purpose of reducing the total population lies between 8 and 10 kR. Doses of 15 kR and higher resulted in deformed butterflies with a short life. (TTT)

41191 THE SORPTION CAPACITY OF THE TISSUES OF RABBITS, SUBJECTED TO IRRADIATION AND TO IRRADIATION AND PHLEBOTOMY. A. F. Karchevskii (Khar'kov Medical Inst.). Radiobiologiya, 4: 637-8(1964). (In Russian)

Following up previous observations concerning the radiation-induced changes in the sorption capacity of tissues, the effect of irradiation and phlebotomy on this property of the tissues of various organs was examined. Radiation sickness was induced in rabbits by exposing them to 1400 R of γ radiation and acute loss of blood was achieved by the removal of 25% of the blood through the femoral artery. The sorption capacity was determined on the basis of the amount of dye adsorbed by the tissue from a 1% solution of neutral red, using a photoelectrocolorimeter for the measurements. The results showed that after three days, the sorption capacity of the liver, kidneys, spleen, and adrenal glands increased; this became even more marked in 5 days in the liver, spleen, and the adrenal glands and in 7 days in the liver, kidneys and the hip muscles. The combined effect of irradiation and loss of blood caused relatively slight changes in the sorption capacity of the tissues, when compared to the effect of the radiation alone. (TTT)

41192 THE DYNAMICS OF THE INJURY TO THE PENETRABILITY OF THE VESSELS OF DOGS IN THE CASE OF ACUTE RADIATION SICKNESS IN A DRY, SUBTROPICAL CLIMATE. V. V. Bakanskaya (Medical Inst., Grodno, USSR and Medical Inst., Dushanbe, USSR). Radiobiologiya, 4: 638-9(1964). (In Russian)

The hemorrhagic syndrome, due to disturbances in the penetrability of the blood vessels, plays an important role in the pathogenesis of the radiation sickness. In view of the known importance of temperature in these processes, the penetrability of the vessels was examined in dogs suffering from acute radiation sickness, under the natural conditions of a dry, subtropical climate. The radiation sickness was induced in the animals by a single exposure to 400 to 450 R of x radiation, at a dose rate of 4.5 to 5 R/minute. The penetrability of the vessels was measured by means of ^{131}I-labeled serum. It was noted that the third day after the exposure the condition of the dogs changed markedly: they refused to drink and became sluggish; simultaneously, the penetrability of the vessels increased. This became more marked by the fifth day. At that time, the intravenously injected labeled protein appeared in the lymph tissues in 8 minutes in the healthy animals and in only 3.6 minutes in the irradiated ones. It is concluded from the data that the dry, subtropical conditions cause an acute form of the radiation sickness with severe symptoms and a marked shortening of the life of the irradiated dogs; the changes in the penetrability of the vessel are involved in these effects. (TTT)

41193 THE RADIOBIOLOGICAL EFFECT ON MICROORGANISMS IRRADIATED BY MEANS OF A RADIOACTIVE ANODIC FILM OF ALUMINUM OXIDE. A. F. Bogoyavlenskii, V. F. Bogoyavlenskii, I. F. Bogoyavlenskii, N. K. Matyazh, and L. S. Rachevskaya (Kazan Aviation Inst.; Kazan State Medical Inst.; and State Medical Inst., Blagoveschensk-on-the Amur, USSR). Radiobiologiya, 4: 640-2(1964). (In Russian)

In order to avoid the problem of scattering of the radiation, usually encountered when working with point sources of radiation, anodic films formed on the surface of Al sheets were used to incorporate radioisotopes, such as ^{32}P, ^{35}S, ^{60}Co, ^{65}Zn, ^{165}W, ^{14}C, etc. The low-level radioactive surface sources thus obtained are safe to handle and are resistant against mechanical wear and chemical leaching out. These uniformly distributed surface sources were used to study the behavior of microorganism exposed to radiation. Tests carried out with Saccharomyces cerevisiae indicated that the β radiation from the source does not affect the survival rate of the cells although it reduces their reproduction rate. Experiments were also carried out by this method to determine the sensitivity of the microflora in the human respiratory tracts toward antibodies, while exposed to radiation. The phlegm specimens from patients were placed in contact with penicillin, biomycin, streptomycin and levomycetin, covering the dish with the radioactive Al_2O_3 layer for 24 to 48 hours. Under these conditions, the levomycetin was found to be most effective. The method is considered useful as a research tool to evaluate the differential activity of the various antibiotics. (TTT)

41194 THE ACTION OF IONIZING RADIATION AND OF THE CORIOLIS ACCELERATION ON THE FUNCTIONAL STATE OF THE VESTIBULAR APPARATUS. V. S. Nesterenko. Radiobiologiya, 4: 643(1964). (In Russian)

Under conditions of space flight, the astronaut is continuously exposed to the Coriolis acceleration which consists of any supplementary motion, in addition to the movement of the spaceship. This causes irritation in the vestibular apparatus. In addition, the effect of radiation must also be taken into consideration. In order to evaluate these factors, the changes of the sensitivity toward the Coriolis acceleration was examined in rabbits, simultaneously exposed to radiation, by irritating the labyrinth until the vestibular somatic reflex was obtained. The animals were subjected to Coriolis accelerations of 0.13, 0.26, 0.39, and 0.52 m/sec^2 and to 800 R of γ radiation. The results indicated that the threshold sensitivity of the irradiated animals was greatly affected: within 2 hours there was a maximum in the sensitivity; 5 hours after the irradiation there was a tendency toward the normal excitability. Within 24 to 30 hours the sensitivity decreased strongly, with a recovery during the 3rd to 5th day, followed by a gradual increase up to the death of the animal. (TTT)

41195 ON THE BIOLOGICAL EFFECT OF SMALL DOSES OF INTERNAL RADIATION. Muscheg G. Durmischian (Academy of Sciences, Moscow). Radiol. Austriaca, 13: 29-52(1962). (In German)

Observations of the effect of small doses of ionizing radiation from ^{24}Na on physiological functions in rats, rabbits, and dogs were made. Although this radioisotope is distributed rather uniformly throughout the organism, several body organs and systems exhibit widely varying sensitivity to this radioisotope. The effect of small doses of internal radiation on the arc of an unconditioned motor reflex (reflex time) and on conditioned reflexes, hypophyseal function, adrenal cortex and medulla, blood pressure, morphological characteristics of blood, skin permeability, kidney function, cholinesterase activity, tissue N concentrations, serum protein, and tissue capacities for binding of neutral red, were studied. The nervous system was functionally radiosensitive, but it was very radioresistant morphologically. Administration of 1 μC of ^{24}Na to 250-g rats, giving an internal radiation dose of $\sim$0.09 r/week resulted in a very marked shortening of reflex time on the first day. A 200- to 500-fold increase in dose extended reflex times. In the endocrine system, the kidneys, and the hematopoietic system small doses produced stimulation of function, but increased dosages produced an initially brief stimulation, followed by depression of function. When very small doses of radiation were administered along with other factors, such as very small amounts of chemicals or drugs, an enhanced reaction was observed in the organ systems studied. This suggested a summation effect. Studies of excretion of radioisotopes have shown that these processes depend on the amount of isotope administered, its type, age of the animals, nutritional status, etc. It is possible that increases in the natural radiation environment that have resulted from atomic weapon tests may have a greater danger for human populations if the effects of very small amounts of radioisotopes shown by this study are taken into account. (BBB)

41196 RADIATION HAZARDS, RADIATION INJURIES, AND RADIATION PROTECTION OF THE EYE. E. Krokowski and U. Ehling (Freie Universität, Berlin). Radiol. Austriaca, 14: 57-65(1963). (In German)

Experiments were conducted on 400 rabbits to determine the radiosensitivity of various parts of the eye. The left eye was x irradiated and compared with the right eye as a control. The results indicated that the cornea is relatively insensitive to radiation; doses up to 2000 R caused no reaction, and higher doses in most instances caused reparable damage. The retina showed no changes up to doses of 3000 R; only radiation-caused hydrophthalamus raising the pressure within the eye caused changes in the retina. Primary injury to the vitreous body did not appear and was found only after complete destruction of the lens. The growth of the ocular bulb was inhibited in young animals after irradiation; 1000-R irradiation caused a deficiency in its wt of 12%, 2000 R a 40% drop. The growth of the orbit was also hindered. The optic lens is the most sensitive part of the eye and responds to radiation by opacification or by developing cataracts and a change in wt. The relationship between age and radiation injury resulting from eye therapy in man is discussed. Measures for protecting eyes of radiologists and those concerned with fluorescent paint manufacture are presented. (TCO)

41197 A CONTRIBUTION TO THE KNOWLEDGE OF QUANTITATIVE CHANGES IN INTERKINETIC NUCLEI AFTER X-RAY IRRADIATION. Vladimir Srb (Charles Univ., Hradae Kralove, Czechoslovakia). Sb. Ved. Praci Lekar, Fac. Karlovy Univ. Hradci Kralove, 6: 577-81 (1963). (In Czech)

A study was made of the influence of x irradiation (dose of 1000 R) on possible quantitative changes in the nuclei of epidermal cells of the onion *Allium cepa*. It was found the ionizing irradiation was responsible for changes in the interphase nuclei, and their course is described 2-4 hrs, 1, 2, and 7 days after irradiation. The nuclei are lighter from 2 hr till the second day after irradiation. On the seventh day, on the contrary, they are heavier in wt in the experimental material as compared with the controls. This is explained by an initial depression of DNA synthesis after irradiation, followed by an increase. The amount of DNA as well as of RNA rises and the nucleus increases in both size and wt. (BBB)

41198 THE ALTERATION OF THE RADIATION SYNDROME BY A "THERAPEUTIC" SPLENECTOMY. R. Fridrich (Universität, Basel). Schweiz. Med. Wochschr., 93: 371-3(Mar. 2, 1963). (In German)

Male albino mice (366) were exposed to whole-body x radiation amounting to 650 R. Of these, 177 were splenectomized in groups of 18 to 22 animals at intervals of 15 min, 30 min, 1, 2, 3, 4, 5, 24, and 48 hr after irradiation. At corresponding time periods a portion of the omentum was removed from the other 189 mice. The survival rate was slightly greater in the animals that had been splenectomized after irradiation than in the control irradiated animals when the time interval between radiation and operation was 24 hr or less. For this interval the greatest effect was observed at intervals up to 4 hr. The death rate of the splenectomized animals was ~15% lower than in the omentectomized animals during this early interval, but for periods of time greater than this the type of operation performed had no effect on the survival rate. Two possible mechanisms of reaction may help to explain these results. One is that the stress of the operation performed may have had some effect, but supplementary studies seemed to indicate that it made no difference in survival rate whether the operation was performed before or after the radiation exposure. A second possible explanation of the effects of splenectomy that were observed may have been the decreased concentration of some specific toxic substance in the blood, which was lowered by removal of the spleen. This could have been some toxic splenic breakdown product produced by radiation whose entry into the blood stream was hindered by splenectomy. (BBB)

41199 RADIATION ACTION ON DNA IN BACTERIA: EFFECT OF OXYGEN. Ernest C. Pollard and Phillip M. Achey (Pennsylvania State Univ., University Park). Science, 146: 71-3(Oct. 2, 1964).

In *Escherichia coli* cells ionizing radiation produces a degradation of DNA to approximately 50% of the total amount originally insoluble in trichloroacetic acid. There is also a reduction of synthesis. Oxygen inhibits the degradation process by a dose reduction factor of 4 and the synthesis process by a factor of approximately 1.5. Thus, at relatively low doses, radiation action on bacteria is very probably mediated through the DNA. (auth)

41200 RADIATION INJURY AND AUTOLYSIS. W. N. Benewolenski. Sowjetwiss. Naturwissenschaftl. Beitr., 5: 451-65(May 1961). (In German)

Differences in radiosensitivity of animal tissues are correlated with biochemical changes, such as decreased protein and increased urea, creatinine, and ammonia concentrations. In irradiated animals tissue hemolysin factors have been detected that are formed during autolysis of normal tissues. These substances are essentially lipids, consisting of unsaturated fatty acids, lysolecithin, and steroid compounds. Normally, they are bound to proteins or other similar compounds, so that their hemolytic activity is not apparent until these compounds are destroyed by enzymatic action initiated by exposure to radiation or during postmortem autolysis. Evidence indicates that the autolysis-like processes evoked by radiation in animals may be due to depression of oxidative phosphorylation, that, in turn is caused by some unknown processes of enhancement of the primary radiation effects. However, in the intact organism it is very difficult to detect the existence and development of any series of reactions which might cause this. Besides the possibility of there being some series of reactions initiated by irradiation which could produce the autolysis-like behavior of the tissues, there are secondary factors, such as disturbances of circulation, endocrine glands, or the nervous system, which all might contribute to accelerating the appearance of the autolytic processes. (BBB)

41201 ELECTRON MICROSCOPE STUDY OF THE EFFECTS OF IONIZING RADIATION ON THE FINE STRUCTURE OF LIVER AND SPLEEN OF MICE. Konrad Morgenroth, Jr., and Hermann Themann (Universität, Munster, Ger.). Strahlentherapie, 124: 547-69(Aug. 1964). (In German)

Electron microscopic studies of the liver and spleen of mice were done after total body irradiation with 9000, 3000, and 300 R of 200-kv-x rays and ^{60}Co γ rays. Consistent with the literature the degree of damage was found to be dependent on the dose height and the time passed after irradiation. A degeneration phase, a latent phase, and a regeneration phase could be observed during the course of damage. The vacuolar degeneration of the mitochondria and the changes in endoplasmatic reticulum could be observed step by step. Comparison of the irradiation series after ^{60}Co irradiation with the ones after 200-kv-x ray irradiation showed no basic difference in effect of these two radiation kinds. Only a significant temporal displacement of the several phases of the damage course could be observed. In this case a dependency upon the radiation quality was recognizable. (auth)

41202 EFFECTS OF IONIZING RADIATION ON MONOAMINOXYDASE ACTIVITY IN LIVER AND BRAIN OF WHITE MICE. Otfried Strubelt (Universität, Erlangen, Ger.). Strahlentherapie, 124: 570-2(Aug. 1964). (In German)

The monoamino oxydase content in liver of white mice is significantly decreased by the 4th and 7th day after total body irradiation with 700 R, while it is not changed in brain. The decreased monoamino oxydase activity of liver is probably the cause of increased effectiveness of some sympaticomimetic amines during the post irradiation period. (auth)

41203 HISTOLOGICAL STUDIES OF THE EFFECTS ON EMBRYONAL DEVELOPMENT IN THE MOUSE OF X IRRADIATION. I. REPORT: EARLY EMBRYONAL CHANGES AND EFFECTS ON EYE DEVELOPMENT. Heinz Kriegel and Kyoko Shibata (Universität, Freiburg i. B. and Heilgenberg-Instituts, Ger.). Strahlentherapie, 124: 573-87(Aug. 1964). (In German)

Histological investigations were done at different times after the radiation insult at the 5th and 8th day of pregnancy in mice embryos irradiated in utero. In all of the cases a retardation of the embryonic development after irradiation could be observed. If irradiation is done at the time of ovum implantation into the mucous membrane of the uterus, an influence upon the implantation events has to be expected in addition to a direct damage of the embryo. The problem concerning the causes for the development of malformations is discussed by using eye development as an example. (auth)

41204 THE QUESTION OF THE EFFECTS OF IONIZING RADIATION ON THE SH-GROUPS IN TISSUE. Guenter Siegel (Humboldt-Universität, Berlin). Strahlentherapie, 124: 588-98(Aug. 1964). (In German)

In aqueous solution, tellurit is reduced to tellur by cysteine. Cysteine is oxidized to cystine. Using sufficient cysteine concentrations, these reactions are accelerated by the influence of x rays. This acceleration of the reduction by skin sulfhydryls cannot be observed during x irradiation of an isolated pig ear which was perfused at the same time with tellurit solution. After application of an extremely high x-ray dose and following perfusion, the normal reduction of tellurit could not be observed any more. This indicates, that the concentration of skin sulfhydryls is decreased after x irradiation. (auth)

41205 INVESTIGATION OF A BIOLOGICAL RADIOPROTECTOR. 55. REPORT: TIME DEPENDENCE OF CHANGES IN RADIOSENSITIVITY AFTER OPERATIVE TREATMENT IN EXPERIMENTAL ANIMALS. Kurt Flemming and Christa Flemming (Universität, Freiburg i. B. and Heiligenberg-Instituts, Ger.). Strahlentherapie, 124: 617-25(Aug. 1964). (In German)

Female mice and male rats were x irradiated (mean lethal dose) 1 to 6 days after omentectomy or splenectomy. Regardless of the type of operation mice showed an increased radiation resistance, if irradiated on the 1st or 2nd day after operation. A decreased radiation resistance was observed when irradiations were done on the 4th or 5th day after operation. Only small and irregular fluctuations in the radiation sensitivity were observed in rats. The results obtained can be explained by the development of a general adaptation syndrome resulting from the operation. If irradiation is done at the time of the contra shock phase, an increased radiation resistance is observed because of crossed resistance. Radiation resistance is decreased, if irradiation is done immediately after the contra shock phase (4 to 5 days after operation). Time dependency of the radiation protective effect of ethylenpalmitate and endotoxins makes it desirable to take the non-specific reaction of the organism and the behavior of the adrenal cortex more into consideration, even with experiments concerning chemical radiation protection. (auth)

41206 EXPERIMENTAL RESEARCH ON THE BIOCHEMICAL CHANGES AND BIOLOGICAL REACTIONS PRODUCED BY IRRADIATION. PRELIMINARY NOTE. CHANGES IN THE LEUKOCYTE COUNTS OF WHITE MICE AFTER ACUTE IRRADIATION. T. Roxin, Speranta Marinescu-Halunga, and Cornelia Olaru (Inst. of Internal Medicine, Bucharest). Studii Cercetari Med. Interna, 4: 687-95 (1963). (In Rumanian)

As part of a more complete investigation of the lesions caused by ionizing radiation, principally those preceding the appearance of radiation-induced hematologic diseases, a study was made of the variations in the white blood cell series following a single x-ray dose of 400 R. The white cell count was performed in 91 mice, two, six, 12, 24, 48, and 72 hr and seven, 14, 21, and 28 days postirradiation, at which latter times the normal blood picture had been restored. The cell counts showed an immediate and transitory leukocytosis accompanied by lymphopenia, which reached its peak at the end of the 2nd hour, and was followed by leucopenia which increased progressively until the seventh day. After this time there was a slow increase in white cell count until a normal count was reached at day 28. The importance of hematologic examinations in radiobiological studies was discussed, also the value of statistical analyses in this type of experiment. (BBB)

41207 MORPHOLOGICAL MODIFICATION IN THE EFFECT OF GAMMA IRRADIATION. P. Ya. Gerke. Tr. Inst. Eksperim. i Klinich. Med., Akad. Nauk Latv. SSR, 28: 5-8(1962). (In Russian)

A review is given of studies on the morphological modifications taking place in organs of animals exposed to a single 700-R dose of γ radiation and fed a high protein-vitamin diet. (R.V.J.)

41208 DEVELOPMENT OF RENAL CARCINOMA AFTER THOROTRAST PYELOGRAPHY. K. Kureckemeyer (Staedtische Krankenhauses, Berlin). Urologe, 2: 73-6 (Mar. 25, 1963). (In German)

Renal carcinoma is reported in a 59-yr-old man who had undergone retrograde pyelography with Thorotrast ~29 yr previously. X rays showed evidence of Th deposition within the left kidney which was removed and found to be fibrotic. Greatest Th deposition was found in the kidney pelvis and parenchyma with proliferation of the epithelium, and formation of a malignant tumor. (TCO)

41209 EFFECTS OF ULTRAVIOLET RAYS ON MAIZE. A. T. Seisebaev. Vestn. Akad. Nauk Kaz. SSR, No. 6, 61-6(June 1964). (In Russian)

Studies showed that seeds exposed for 10 to 25 min germinate faster. Repeated exposures of 60, 120, and 180 min induced certain modifications that improve germination and harvest. (R.V.J.)

41210 POST-IRRADIATION DEVELOPMENT OF CHROMOSOMAL DAMAGE IN SEEDS. Harlan Quinn Stevenson. Thesis. Gainesville, Fla., Univ. of Florida. 1963. 86p.

The radiosensitivity of barley grains was altered by conditions of water content and oxygen tension at the time of irradiation with ^{60}Co gamma rays and during post-irradiation storage. There was a high positive correlation ($r > 0.85$) between seedling height and per cent normal metaphases for all conditions that were examined, viz.: (1) seeds of 2.8% water content irradiated in air or oxygen with doses from one to 36 kR and stored at least five days; (2) seeds with water contents up to 15.5% irradiated in air with doses up to 50 kR, and stored at least six days under the same conditions as those when irradiated; (3) seeds with 3.8% water content irradiated in nitrogen with doses up to 75 kR and then either germinated immediately or stored at least four days in nitrogen, or air, or oxygen under positive pressures up to 200 pounds. The high positive correlation applies not only to mean values between treatments but to individuals within treatments as well, and was most striking in experiments with seeds both irradiated and stored at water contents below three per cent. This treatment results in great variation in leaf length, which is directly paralleled by individual variation in per cent normal cells. It is concluded that the variable extent of chromosomal damage among individuals within treatments is a sufficient cause for the heterogeneous growth response. The present study suggests that indirect effect on seedling height is mediated through the chromosomes, and that, for it to be modified, there must be either protection or repair of the chromosomes themselves. (Dissertation Abstr., 25: No. 1, 1964)

41211 EFFECTS OF PRENATAL CHRONIC GAMMA IRRADIATION ON THE PRENATAL AND POSTNATAL DEVELOPMENT OF THE ALBINO RAT. Claude Jackson Coppenger. Thesis, College Station, Tex., Agricultural and Mechanical Univ., 1964. 125p.

In order to determine the prenatal, neonatal, and postnatal effects of continuous, low-intensity gamma irradiation on the developing rat, impregnated females were subjected to gamma irradiation at 50 R per 20 hour day, beginning on the first day of pregnancy. Prenatal effects were determined by examination of the embryos, fetuses, and uteri on specific days 10 through 20 of gestation. Irradiation at this level did not affect the total number of embryonic implantations, but 43% of the embryos were eventually killed and resorbed as compared to 15% resorptions in the control group. Most deaths and resorptions occurred prior to the 12th prenatal day in both control and irradiated groups. The prenatal growth of the irradiated embryos and fetuses was greatly retarded. Gross abnormalities were observed in the irradiated late fetus and newborn. In order to study the effects of prenatal irradiation on the newborn and maturing rat, pregnant rats were exposed to 50 R of gamma irradiation during the first 21 days of gestation and allowed to produce litters. The result was smaller litters, decreased birth weight, and decreased viability at birth and during the first postnatal day. The gestation period was increased by one day and parturition processes were prolonged and complicated. The survival of these animals was not altered during 350 postnatal days. No difference in body weight was observed at 350 days. The irradiated females were sterile, as determined by their anestrous state and failure to breed. The irradiated males were also sterile, the testes completely lacking germinal elements. The pituitaries of both irradiated males and females were significantly reduced. A generalized reduction of cerebral size was observed in all the prenatally irradiated animals with less reduction of brain stem and cerebellum. (Dissertation Abstr., 25: No. 1, 1964)

41212 THE EFFECTS OF PRENATAL EXPOSURE TO IONIZING RADIATION ON THE DEVELOPMENT OF THE SPANISH GOAT. Coleman A. O'Brien. Thesis, College Station, Tex., Agricultural and Mechanical Univ., 1964. 71p.

A study was made to determine the effects of prenatal gamma radiation administered open air from a 1300-C ^{60}Co source upon offspring of Spanish goats. Six controls were not irradiated, 29 does were given 300 R; 17 received acute dosage, six on day 30, five on day 40, and six on day 50 of gestation. Six does received fractionated dosage, 100 R each on days 30, 40, and 50 of gestation. Six does received continuous irradiation from day 30 to day 50 of gestation. Four does died of irradiation sickness. Of the 25 irradiated does surviving, 44% produced young for a 64% kid crop. All six of the control does survived and 50% produced young for a 100% kid crop. One doe in the 30-day acutely irradiated group produced a female kid with multiple anomalies. Statistical treatment of weight means for seven treatment groups at 150 days of age was significant for irradiated compared to control animals. Semen evaluation was based on seven collections starting at 126 days and terminating at 189 days of age. Irradiated males were inferior in comparison with controls by all criteria employed in evaluation; however irradiated animals made rapid recovery during the collection period. Organ weights were obtained at the time of sacrifice and analyses of variance were calculated between treatment groups within sexes. Fractionated and acute 50-day male groups had highly significantly smaller pituitaries than male controls and fractionated males were significantly smaller than the single continuously irradiated male. Irradiated male testes weights were 15% less, adrenal weights were 25% less, and epididymides weights were 28% less than controls. Female organ weights did not differ significantly. Gamma irradiation adversely affected the reproductive performance of the irradiated does as evidenced by a lower conception rate and a smaller kid crop than the controls. The offspring were also adversely affected as indicated by a lowered survival rate, decreased growth rate, lighter organ weights, lower follicle development and decreased and delayed semen and sperm development with a pronounced increase in morphologically abnormal sperm. (A.G.W.)

41213 DEOXYRIBONUCLEIC ACID SYNTHESIS IN THE IRRADIATED RAT EMBRYO. Richard Gallant Skalko. Thesis, Gainesville, Fla., Univ. of Florida, 1963. 89p.

Female albino rats of a Wistar strain were exposed to either 135 or 270 R of ^{60}Co radiation on the morning of gestation day 11. Autopsy on day 20 revealed that the lower dose produced a slight increase in the degree of resorption, no effect on fetal weight, and no malformations in the survivors. The higher dose produced a large increase in the degree of resorption, a pronounced effect on mean fetal weight, and many malformations. ^{32}P was injected into irradiated and non-irradiated pregnant females to study DNA synthesis in individual litters at various times after irradiation. DNA synthesis was suppressed in both series of irradiated embryos within 3 hours after irradiation, the higher dose producing the larger amount of suppression. The same relationship was maintained at 6 and 12 hours after irradiation but at 12 hours, the degree of isotope incorporation was approaching control values. At 24 hours after irradiation, no significant difference was observed in the degree of DNA synthesis in control and irradiated embryos. Isotope incorporation increased with increasing time after injection and no difference in the shape of the incorporation curves was observed between control and irradiated embryos at all times studied. The degree of DNA synthesis over the 24-hour period studied decreased in control embryos, was maintained at a constant level in the 135-R treated embryos and increased significantly in the 270-R treated embryos. (Dissertation Abstr., 25: No. 1, 1964)

41214 THE INFLUENCE OF METABOLIC STATE AND GROWTH PHASE ON ULTRAVIOLET KILLING OF ESCHERICHIA COLI STRAIN $15T^-A^-U^-$. David Mark Ginsberg. Thesis, Knoxville, Tenn., Univ. of Tennessee, 1963. 118p.

Ultraviolet radiation (UV) inactivation and photoreactivation (Phtr) of the bacterium Escherichia coli strain $15T^-A^-U^-$ (15TAU) were studied. This strain requires thymine (T), arginine (A), and uracil (U) for normal growth. Deletion of T, A, or U from the growth medium inhibits normal synthesis of DNA, protein, or RNA, respectively. A logarithmic culture in which normal protein and RNA synthesis have been directly inhibited for 90 minutes by withdrawal of A and U (–AU culture) has the same UV (2537Å) and gamma-ray survival curves as a normal stationary phase culture. Furthermore, 30-minute-old lag phase cultures obtained by subculture of –AU and normal stationary cells, respectively, have the same UV survival curves and the same photoreactivable sectors. The UV survival curve of logarithmic phase 15TAU is sigmoid with a multiplicity of two. For stationary and –AU cultures, the multiplicity of the survival curve becomes 100, but the final slope is unchanged. For the same UV dose, the photoreactivable sectors and Phtr rates are the same for logarithmic, stationary, and –AU cultures, and neither the final slope of the UV survival curve nor the photoreactivable sector changes during the lag phase transition from stationary or –AU to logarithmic phase. No correlation could be established between radiosensitivity and nuclear number or amount of DNA per cell. However, differences in multiplicity of the UV survival curves among cells in different growth phases are roughly parallel to the differences observed for delay in cell division of unirradiated cells in liquid medium when they are plated on a solid medium. The length of delay in cell division depends on the growth phase of the liquid culture. The usual post-UV lysis of logarithmic phase cells is prevented if protein synthesis is temporarily inhibited; however, this treatment does not affect survival. An appendix treats evidence on the occurrence of DNA synthesis in cells in which normal protein and RNA syntheses are inhibited. (Dissertation Abstr., 25: No. 1, 1964)

41215 RADIATION RESISTANCE OF SOIL BACTERIA IN THEIR NATURAL STATE. Gerard Roland Vela. Thesis, Austin, Tex., Univ. of Texas, 1964. 125p.

The effect of gamma rays on segments of the soil microflora was studied. The rate of reduction at atmospheric nitrogen is not affected when 150 kR of gamma rays are administered to a few thousand Azotobacteraceae in situ in one gram of soil. The nitrifying bacteria present in one gram of soil are not eradicated by 1,000 kR of gamma rays, although the populations are diminished. As a result, the appearance of nitrite and nitrate in the culture supernatant is delayed. The rate of appearance of nitrite is greater in the irradiated soils than in normal soils. The liberation of gaseous ammonia from urea is enhanced, within limits, by increasing doses of radiation. Comparisons of the radiation resistances of soil azotobacter and the same organisms after being cultured in the laboratory show that the soil bacteria are vastly more resistant to gamma rays. The difference in resistance was shown to be the result of growth and cyst formation in natural soil or in soil amended with mannitol. Encystment in cultures of azotobacter was detected and monitored by the use of a novel staining procedure. (Dissertation Abstr., 25: No. 1, 1964)

41216 BIOLOGICAL AND HISTOPATHOLOGICAL EFFECTS OF GAMMA RADIATION ON THREE LIFE STAGES OF ANTHONOMUS GRANDIS BOHEMAN. Marion Sidney Mayer. Thesis, College Station, Tex., Agricultural and Mechanical Univ., 1963. 154p.

A study of the effects of gamma radiation on the boll weevil was accomplished in three major phases. The first phase tested the hypothesis that the amount of mating by boll weevils is a function of age and/or the length of time males and females are confined together. In this series of investigations the amount of mating in a 24-hour interval was linearly related to the increase in age of the male and was not dependent upon the age of the female. The second phase of the study was designed to test the effect of gamma radiation on egg-hatch, pupal eclosion, and adult longevity. Adults from irradiated eggs and pupae were mated. Most of the dose-response curves were approximately sigmoid. Adults that developed from eggs and pupae that had been irradiated did not live as long as the control insects. Matings indicated that no dosage tolerated by an immature stage was sufficient to sterilize the resulting adult. However, 8,000 R was found to be sufficient to sterilize adult males that were 12 and 36 hours old at the time of treatment. Females treated with 8,000 R laid virtually no eggs and died sooner than the controls. The third phase of research was a study of the histology of the testes, ovarioles, and midgut at various times after treatment with 8,000 R. After treatment the testes decreased in size, and after five days they resembled a sac-like mass of sperm with few or no meiotic patterns visible. The nurse and follicle cells were affected most adversely in the female reproductive system. The effect on the midgut cells was an inhibition of mitosis within the regenerative nidi, with consequent slow degeneration of the midgut epithelium. (Dissertation Abstr., 25: No. 1, 1964)

41217 PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF X-IRRADIATED DOGS TO INDUCED MUSCULAR CONTRACTIONS IN VIVO. Chester Ching-tong Liu. Thesis, Knoxville, Tenn., Univ. of Tennessee, 1963. 135p.

Certain physiological and biochemical responses of normal and x-irradiated dogs to protracted, induced muscular contraction were studied in vivo. The experimental animals were given a single wholebody x-irradiation exposure of 700 or 800 R and the increased muscular activity was induced three to four days post-irradiation. The leg movement was recorded and the muscular work was calculated. Similar responses of normal and x-irradiated animals to muscular contraction demonstrated that the muscular work decreased approximately 45 per cent after one hour from its initial value and then remained at a relatively constant level throughout the three-hour experimental period. The glycogen content of the stimulated muscle was reduced and the venous blood hematocrit was increased. Accumulation of sodium and diminution of potassium content in the contracting muscle was observed in normal but not in x-irradiated animals. The rate of blood flow to the stimulated muscle was greater in the x-irradiated animals than in the normal group. The utilization of muscle phospholipids and gain of total muscle water in the x-irradiated dogs were both significantly higher than that in the normal animals. Liver cholesterol concentration in the x-irradiated animals was reduced and the potassium content was elevated as compared with the liver of normal animals. (A.G.W.)

41218 BIOLOGICAL EFFECTS OF NEUTRON AND PROTON IRRADIATIONS. VOLUME II. Proceedings of the Symposium Held at the Brookhaven National Laboratory, Upton, New York, 7-11 October, 1963. (International Atomic Energy Agency, Vienna). Proceedings Series. May 1964. 454p. (STI/PUB/80(Vol.II)). $9.00; SCH 189.-; 54s.stg; F.fr. 36.-; DM 31.50(IAEA).

Twenty-five papers and a panel discussion were presented. Separate abstracts were prepared for the panel discussion and 16 papers. Nine papers were previously abstracted in NSA, 17: 37138; 18: 1372, 1374, 1375, 3479, 3494, 8099, 11654, and 21828. (H.M.G.)

For abstracts of individual papers see: 41219, 41220, 41221, 41222, 41223, 41224, 41225, 41226, 41227, 41228, 41229, 41230, 41231, 41232, 41233, 41234, and 41299.

41219 FAST-NEUTRON IRRADIATION OF LARGE ANIMALS. A. L. Batchelor and P. W. Edmondson (Medical Research Council, Harwell, Berks, Eng.). p.3-13 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

The graphite-moderated, air-cooled reactor BEPO was modified to provide an area (Sack Hole) of about 14 square feet in which large animals can be irradiated approximately uniformly by fast neutrons produced in a uranium converter plate. The mean energy of the fast neutrons is about 0.7 Mev, and the dose rate is 2500 rad/h. A second similar Sack Hole contains a cadmium converter plate which gives predominantly gamma-radiation of about 2.5 Mev mean energy, and a dose rate of 1850 rad/h. These two Sack Holes are being used to determine the neutron RBE for acute killing in large approximately man-sized animals. Hematological and biochemical as well as morbid-anatomical observations are being made. The experiment is still in its early stages and preliminary results are presented. (auth)

41220 PULSED IRRADIATION STUDIES IN MICE, RATS AND DOGS. E. J. Ainsworth, G. F. Leong, K. Kendall, E. L. Alpen, and M. L. Albright (Naval Radiological Defense Lab., San Francisco). p.15-30 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

Radiation lethality as a function of radiation dose rate was extensively explored over the range of less than one rad to a few hundreds of rad/min, but comparatively little is known of the biological consequences at exposure intensities of the order of 10^5-10^6 rad/min. In the present experiments radiations produced by a TRIGA reactor were used to study the comparative acute-mortality responses (LD$_{50/30}$) of mice and dogs irradiated either at moderate dose rates (40 or 100 rad/min for mice and 23 rad/min for dogs) or by a single high dose-rate radiation pulse ($\sim 10^6$ rad/min for mice and $\sim 2.0 \times 10^5$ rad/min for dogs). In the mouse experiments, the LD$_{50/30}$ of animals exposed at the moderate dose rates of 40 rad of n/min or 100 rad for gamma-radiation/min was not significantly different from the LD$_{50/30}$ of animals exposed to the same radiation given as a pulsed exposure. Likewise, in acute mortality studies conducted with unilaterally neutron-irradiated dogs, no significant differences in LD$_{50/30}$ were found between groups irradiated at 23 rad/min or exposed to pulsed dose rates in excess of 1.5×10^5 rad/min. Other studies were conducted to determine if recovery from radiation injury in mice, as estimated by the split-dose irradiation technique, is influenced by the rate at which the initial sublethal injury is produced. Recovery has been compared at 5 and 14 days post-irradiation in groups of animals exposed at either 40 or 9×10^4 rad/min and no dose-rate dependency of recovery was detected. (auth)

41221 ACUTE INJURIES WITH 14.1-Mev FAST-NEUTRON IRRADIATION IN MICE. F. Hirose (Hiroshima Univ.). p.31-54 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

Doses of 14.1-Mev fast neutrons were given to both sexes of six to ten weeks old ddN (CLEA) mice. The data obtained from these experiments were compared with the effects of x irradiation with equivalent absorbed dose or identical RBE doses for acute death. In the case of irradiation with identical absorbed dose of 350 rad, the effects of the fast neutrons on the hematopoietic tissues were generally more severe than those of x rays. The damage of the hematopoietic bone marrow with the fast neutrons was heavier than with x rays, although it was milder than the damage of the lymphatic tissues with the fast neutrons. The acute injuries in the gastrointestinal mucosa, lymphatic tissues, and bone marrow with 700 and 510 rad of the fast neutrons were more severe as compared with those with 784 and 570 rad of x rays, identically effectual for acute death (RBE of 14.1-Mev fast neutrons to 180 kVp x rays for acute death = approximately 1.12). However, the difference between both radiations in the extent of the damage of the bone marrow was smaller than it was in soft tissues. There was noticeable damage in the blood vessels of the spleen and reticular cells of the lymph nodes in mice irradiated with fast neutrons. A dose of 700 rad of 14.1-Mev fast neutrons was superlethal for eight-weeks old ddN (CLEA) mice. However the survival rate of mice given homologous bone marrow transplantation following irradiation with 700 rad was 50%. Therefore it is considered that the injuries in the hematopoietic bone marrow may play a significant role as a cause of acute death from fast neutrons. It was reported that the energy of fast neutrons resorbed in the bone marrow of the mouse might be reduced by about 10% in contrast to that in the soft tissues, and that the energy of x rays resorbed in the bone marrow might be increased by approximately 10%. However, in our experiments the damage in the bone marrow from fast neutrons was more severe than that from x rays. According to these previous reports and our experimental data, it may be concluded that the effects of fast neutrons for tissue damage are more powerful over 20% than those of x rays. (auth)

41222 COMPARISON OF CLINICAL AND LABORATORY RESPONSES IN SHEEP AND DOGS FOLLOWING WHOLE-BODY EXPOSURES TO 250-kvp X-RAYS AND FISSION-SPECTRUM NEUTRONS. M. A. Quaife, J. deBoer, R. K. Jones, A. T. Ichiki, W. R. Godden, H. Davis, and R. E. Engel (Kirtland AFB, N. Mex.). p.73-91 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

Fifteen sheep and eight dogs were exposed to 400 rad (air dose) of pulsed fission-spectrum neutrons, and an equal number of sheep and 14 dogs to 400 R (midline air dose) 250-kVp x rays. Seven additional sheep and four dogs served as unirradiated controls. Control data were obtained for two weeks preceding the exposures and at frequent and regular intervals after the injury. In sheep, the most consistent clinical change was complete loss of wool by the 51st day post-exposure. The underlying skin was pink in color closely resembling that of a mild blush sometimes noted in humans. Dogs did not demonstrate loss of hair. Formed blood elements, neutrophils, lymphocytes, and thrombocytes fell rapidly after the radiation in both species. At about post-exposure day 24 recovery in white cell numbers was noted only in the neutron groups. Thrombocyte levels decreased to safe level in both species but somewhat earlier in the dog. Recovery appeared during the third post-exposure week in both species exposed to neutrons, but not in those given x rays. Red blood-cell hematocrits showed significant drops in both groups of dogs by the ninth day, but neither group of sheep exhibited significant decrease in hematocrit values. Plasma ^{59}Fe clearance rates were determined in the experimental subjects as a parameter of measurement of hematopoietic function. Prognostic implications of alteration in this parameter of hemapoiesis are discussed. The most significant gross pathologic changes were confined to the lungs wherein extensive perivascular hemorrhage around the arteries was noted. On microscopic study the area of hemorrhage was observed to be within the advential-connective tissue and periarterial vessels. Thirty-day mortality for dogs was 50% following neutron exposures and 93% after the x-ray insult. In sheep neutrons produced 22% mortality and x rays 80%. (auth)

41223 PATHOGENESIS OF INTRAPULMONARY HAEMORRHAGE IN DOGS EXPOSED TO PULSED FISSION-SPECTRUM NEUTRONS. R. K. Jones, R. E. Engel, and W. R. Godden (Kirtland AFB, N. Mex.). p.93-104 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

Previous comparison in this laboratory of tissue alterations in dogs produced by exposure to 250-kVp x rays and pulsed fission-spectrum neutrons showed general similarity of response. However, the lungs of animals exposed to fission-spectrum neutrons are considerably more susceptible to peribronchial and perivascular pulmonary hemorrhage. An attempt was made to define the pathogenesis of this lesion by exposing five beagles to 400 rad (MAD) fast neutrons from a bare GODIVA-type reactor and serially sacrificing the animals at periodic intervals. Gross pathologic alterations consisting of occasional small peripheral-pulmonary hemorrhages were discernible at five days post-irradiation. These became progressively more numerous by the ninth day. The most striking changes occurred at + 13 days, consisting of extensive perivascular hemorrhage around pulmonary-arterial branches from the hilum to the pleural surface. The earliest histologic changes observed in the lungs occurred at five days, consisting of focal well-demarcated areas of alveolar congestion, swelling of capillary-endothelial cells and slight alveolar extravascularization of red blood cells. These changes became more generalized by nine days and in addition there were focal areas of peribronchial extravascularization of blood involving the right and left mainstem bronchi. Animals necropsied on the thirteenth day post-irradiation revealed extensive perivascular hemorrhage involving large and small pulmonary-arterial vessels. The blood appeared within the advential-connective tissue and periarterial-lymphatic spaces. Endothelial swelling was extremely marked in affected vessels, but the media appeared essentially unremarkable. Peribronchial hemorrhage was also present adjacent to affected pulmonary-arterial branches. The pathogenesis of these alterations appears to be related to primary endothelial damage produced by pulsed fission-spectrum neutrons. An additional contributing factor is probably thrombocytopenia as the number of marrow megakaryocytes was found to be inversely proportional to the severity of intrapulmonary hemorrhage. (auth)

41224 PATHOLOGICAL FINDING IN MICE EXPOSED TO FISSION NEUTRONS IN THE REACTOR GLEEP. R. H. Mole (Medical Research Council, Harwell, Berks, Eng.). p.117-28 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

Mice were irradiated with fission neutrons liberated from a converter plate exposed to thermal neutrons generated in the graphite moderated uranium reactor GLEEP. The exposure was continuous and either for the duration of life or for limited periods of a number of weeks or months. The information on life shortening has largely been published already. New data are presented on pathological findings and causes of death. (auth)

41225 THE EFFECT OF REGIONAL THERMAL-NEUTRON EXPOSURE UPON THE GROWTH AND TRANSPLANTABILITY OF A MALIGNANT TUMOUR IN THE MOUSE. L. E. Farr and T. Konikowski (Univ. of Texas, Houston). p.157-72 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

In the course of work on effects of thermal neutron: ^{10}B reactions upon transplantable tumors, it was necessary to determine consequences of regional thermal neutron exposure alone. This work done at Brookhaven National Laboratory utilized both Graphite and Medical Research Reactors and the Brookhaven-Swiss white mice strain to maintain transplants of tumor, an experimental anaplastic sarcoma of high invasiveness. Only young male animals were used for study. One series used tumor transplants into the thigh muscle of each of a number of recipient mice. Another series utilized incranial implants to contrast exposed and non-exposed tumors. In all regional exposure studies, the mouse's body was shieled with units containing ^{6}Li or ^{10}B to limit significant thermal neutron exposure solely to the region of the neoplasm. That the exposure was limited to the region of interest was made certain by gold-foil activation data. Two procedures were used to measure thermal neutron effects on the tumor. For intracranial transplants, the animal was sacrificed shortly after neutron exposure. Each tumor was dissected and transplanted intracranially into ten recipient animals to establish if the growth potentiality upon transplant was altered. No changes were observed in tumor take rate or longevity of recipient animals. For thigh transplants the exposed tumor remained *in situ*. The effects were established by using a growth index, the ratio of tumor diameters upon the observed post-treatment day to the diameter upon the treatment day. The growth index in neutron-exposed animals was less than in unexposed animals over a two week interval. These data were also compared with data obtained from animals with thigh-implanted tumors subjected to similar regional exposures but with induction of the thermal neutron ^{10}B reaction. Animals with complete tumor regression were maintained for the remainder of their life up to two and one-half years to observe if tumorigenic sequelae resulted. None did. (auth)

41226 RADIOBIOLOGICAL EXPERIMENTS WITH FAST NEUTRONS, WITH REFERENCE TO THE POSSIBLE VALUE OF NEUTRON THERAPY. D. K. Bewley and S. Hornsey (Hammersmith Hospital, London). p.173-83 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

The use of fast neutrons instead of x rays for radiotherapy has the theoretical advantage of a lower oxygen enhancement ratio. This should make it possible to do greater damage to anoxic tumor cells for a given degree of damage to well-oxygenated normal tissues. Before a clinical trial can be planned it is necessary to measure the radiobiological effects of fast neutrons, in comparison with x rays. This paper extends information previously given. Test systems include damage to the gut of mice measured by four-day lethality and leakage of PVP (^{131}I) through the intestinal wall, and survival curves of mouse cells irradiated in vitro and cultured in vivo. Single and paired doses have been used to compare the effects of fractionated doses of neutrons and x rays. The paper includes details of the collimation and monitoring of the fast-neutron beam, which is produced by allowing 15-Mev deuterons from a cyclotron to fall on a beryllium target. (auth)

41227 RELATIVE BIOLOGICAL EFFECTIVENESS OF 14-Mev FAST NEUTRONS TO Co^{60} GAMMA RAYS IN EINKORN WHEAT. T. Fujii (National Inst. of Genetics, Misima, Japan). p.217-31 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

The RBE of 14-Mev neutrons to ^{60}Co gamma rays was investigated by using the specific locus method in einkorn wheat. F_1 seeds from the cross between the original strain and a Chlorina mutant were used in this study (Chlorina mutant was obtained as a single recessive mutant from x irradiation; it was uniformly light green from seedling stage to maturity with relatively high survival rate and fertility). The F_1 plants showed normal green color and normal growth habit. Dormant F_1 seeds were irradiated at 0.5, 1.0, and 1.4 krad of fast neutrons and 4.3, 8.6, and 12.9 krad of gamma rays. Mutations from dominant normal green to Chlorina occurred by both irradiations and appeared in the leaves and stems of the heterozygotic X_1 plants as longitudinal stripes. Around 80% of seeds germinated in the control lot and in the lowest dosage lots from both neutron and gamma ray irradiations, and germination percentages were gradually decreased with increasing dosage of both kinds of radiation. Moreover, a similar tendency was observed at the early stage as to seedling growth which was gradually inhibited with increasing dosage. According to these results, neutron irradiation was about 13 times more effective than that of gamma rays. Survival rate in the nonirradiated control was about 90% and about 60 to 80% of germinated seedlings survived in 0.5 and 1.0 krad lots from neutron irradiation and all lots irradiated by gamma rays. On the other hand, only about 4% of germinated seedlings survived in the highest neutron lot. No mutation was observed in the control lot, and the number of plants which contained striped tillers increased with increasing dosage of both kinds of radiation. Mutated tillers were observed in about 15% of surviving plants obtained at the lowest dosage of neutron irradiation and a similar frequency was observed from the highest dosage of gamma rays. RBE of 14 Mev neutrons to ^{60}Co gamma rays seemed to be at least 20 for the somatic mutation. (auth)

41228 SPECIES AND TISSUE DIFFERENCES AFFECTING THE RELATIVE EFFICIENCY OF NEUTRONS AND X-RAYS IN PRODUCING CHROMOSOME ABNORMALITIES. A. Marshak (Jefferson Medical Coll., Philadelphia). p.249-66 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

Chromosomes of both plants and animals gave one hit survival curves when irradiated at various intervals during the nuclear interphase by either x rays (220 kV) or neutrons (16 Mev). The RBE was taken as the ratio of the slope of the survival curve on exposure to neutrons at a given time after irradiation to that for x rays at the same time. The time intervals studied were 3, 8, 12, 18, and 24 hr after irradiation. The 3-hr interval gave data for chromosomes which were at the end of the interphase and the 24-hr interval gave data for chromosomes at the onset of the interphase. At the end of the interphase the RBE was a constant for all species studied (five plant, two mammal) and had the value 2.5. In one plant species where RBE was obtained for meiosis at pachytene as well as mitosis at the end of the interphase, it had the same value in both. The constancy of the RBE for mitotic chromosomes in diverse species at the end of the interphase and for meiotic chromosomes at pachytene indicates a uniform condition in all of these chromosomes with respect to ionizing radiation. At the other stages in the mitotic interphase, the RBE varied by as much as 260%. The pattern of RBE variation obtained for a lymphoma of the rat was similar to the pattern for a lymphoma in the mouse and did not resemble the pattern for a carcinoma in the rat. It follows that the chromosomes in these two types of cells in the rat were physiologically different with respect to radiation response even though they might be identical genetically. The Vicia faba root tip gave RBE patterns different from those obtained with any of the mammalian tissues. The factors mentioned above must be taken into account in an evaluation of the relative effects of neutrons on chromosomes. To the extent that survival of cells and organisms is determined by the continued operation of a normal chromosome complement, the RBE for survival will also be dependent upon these factors. (auth)

41229 FAST-NEUTRON IRRADIATION, CELL REPRODUCTIVE CAPACITY, AND THE OXYGEN EFFECT. J. R. Andrews, J. N. Correa, and J. A. Belli (National Cancer Inst., Bethesda, Md.). p.283-91 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

The relative biological effectiveness (RBE) of fast neutron irradiation was determined for many mammalian and other quantitative-cell systems under conditions of oxygenation and anoxia. Such conditions were effected, heretofore, by mechanical, enzymatic, or other mixing or exposure procedures and conditions rather than by physiological exchange. The development of radiation dose-cell response relationships for the impairment of the reproductive capacity of irradiated mammalian cells provides a means for the quantitative determination of radiosensitivity (the reciprocal of the slope of the dose-response curve) and RBE (a complex function of radiosensitivity and of the extrapolation number of the dose-response curve). A mammalian in vivo quantitative tumor cell system (DBA mouse –P388 lymphocytic leukemia, ascitic form) which is physiologically oxygenated under certain conditions was developed and studied for a variety of radiation-exposure conditions in respect to photon and neutron irradiations and to the oxygenation of the system. Quantitative dose-response relationships were developed for these different irradiation conditions (photon and fast-neutron irradiations—oxygenated, hypoxic, anoxic) and neutron RBE's were determined. (auth)

41230 THE EFFECT ON THE TESTIS OF THE MOUSE OF NEUTRONS OF DIFFERENT ENERGIES. A. L. Batchelor, R. H. Mole, and F. S. Williamson (Medical Research Council, Harwell, Berks, Eng.). p.303-10 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

The decrease in the weight of the testis of the mouse at three or four weeks after exposure to a single dose of radiation has proved a simple and convenient means for comparing the relative biological efficiencies of a variety of forms of radiation. A comparison has now been made between fast neutrons of three different energies, 14 Mev (D-T reaction), 3 Mev (D-D reaction) and about 1 Mev (from uranium fission with shielding by lead), each exposure being given in about 20 minutes. The effect of change of exposure time may be derived by comparison with results of single exposures to similarly attenuated fission neutrons where each exposure lasted about 24 hours. (auth)

41231 EVALUATION OF DOSE: COMPARATIVE EFFECT OF FAST NEUTRONS AND OTHER TYPES OF RADIATION ON THE SURVIVAL OF *E. COLI* AND *S. CEREVISIAE*. Y. Arnaud and C. Bocquet (CEN, Saclay, France). p.311-20 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

The EL-3 reactor is equipped with a uranium converter by means of which fast neutrons can be obtained. A bank of fission chambers measures the flux and spectral distribution of the fast neutrons. These miniature detectors are placed at various points in the target zone and make possible the experimental evaluation of the absorbed tissue-dose. This apparatus and dosimetric technique can be used to compare the effect of fast neutrons and other types of ionizing radiation (e.g., x rays) on unicellular organisms. The percentage of survivals and the frequency of a mutation in *Saccharomyces cerevisiae* was studied. The survival curve for *Escherichia coli* was also determined for x rays and neutrons. It was found that the RBE's of these various types of radiation depend not only on the species and the biological criterion adopted, but also on the irradiation dose-level at which the comparison is made. These experiments show the RBE to be also a function of dose. The effects of fast neutrons and x rays are often brought about by differing radiobiological processes. It is arbitrary to establish linear relationships between the doses for these various types of radiation. (auth)

41232 RELATIVE BIOLOGICAL EFFECTIVENESS OF FAST NEUTRONS FOR LATE SOMATIC EFFECTS IN MICE. A. C. Upton, M. L. Randolph, E. B. Darden, Jr., and J. W. Conklin (Oak Ridge National Lab., Tenn.). p.337-45 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

Female RF mice were exposed to whole-body 250-kVp x rays, ^{60}Co γ rays, and fast neutrons from a cyclotron (~1 Mev mean energy) and a Po—Be source (~5 Mev mean energy), beginning at ten weeks of age. Doses of <1.0 to <5000 rad were accumulated at dose rates ranging from ~100 rad/min to less than 0.00007 rad/min (0.1 rad/23 hr), and the resulting effects on survival and on the incidence of various diseases (neoplasms, lens opacities, senile and other degenerative changes) were recorded. The life expectancy of 30 day survivors was shortened ~0.83 day/rad of fast neutrons, irrespective of the dose rate, whereas the life-shortening effectiveness of x and γ rays was ~0.24 day/rad at the highest dose rate and only ~0.10 day/rad at the lowest dose rate. The effectiveness of γ rays was similarly dependent on dose rate for other late somatic effects; hence the RBE of fast neutrons generally increased with decreasing dose rate for these effects. Only in cataract-induction did the RBE exceed 10. In the induction of ovarian tumors, it was unusually low, less than 1.0. Our results imply that multi-hit radiobiological events are important in the pathogenesis of most late effects of radiation and that protection guides for human exposure to radiation must be interpreted in the light of time-intensity variations in the effectiveness of x and γ rays. (auth)

41233 COMPARATIVE ACCUMULATIONS OF INJURY FROM X-, GAMMA, AND NEUTRON IRRADIATION—THE POSITION OF THEORY AND EXPERIMENT. J. S. Krebs and R. W. Brauer (Naval Radiological Defense Lab., San Francisco). p.347-64 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

The theoretical formulation of the process of accumulation of radiation injury postulates that the injury is divided into two types, one of which recovers with time after irradiation, and the other of which is permanent. Experimentally it was shown that both types of injury do exist independently and have magnitudes reasonably in conformity with theory. For a number of types of permanent injury the neutron/gamma RBE is the same as that for acute radiation death. Until recently, the theory was unable to predict correctly the accumulation of injury in animals exposed to chronic irradiation. Recent studies, however, based on short-term (~60 d) chronic LD_{50} studies with x rays, have shown that the kinetics of recovery from the chronic injury are not necessarily those indicated by split-dose measurements. When the correct kinetics of recovery are used, the build-up of radiation injury is correctly predicted. For such limited-time exposures, the neutron/gamma RBE is the same as that for acute radiation death; hence, it is probable that the kinetics of recovery from neutron irradiation injury are qualitatively similar to those for x-ray injury. For long-term chronic exposures (>5 months) the neutron/gamma RBE for accumulation of injury increases sharply over that for acute radiation death, and no satisfactory theory is available to predict the accumulation of injury from any kind of irradiation. For the short-term exposures however, the knowledge of the kinetics of recovery has advanced to the point where the biological basis of recovery and failure to recover can be investigated effectively. (auth)

41234 PANEL ON BIOPHYSICAL CONSIDERATIONS IN NEUTRON EXPERIMENTATION. H. H. Rossi. p.365-428 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

Panelists presented the following discussions: comparison of the mortality response of different mammalian species to x rays and fast neutrons; classification of neutrons, biological indicators of RBE, late effects based on criteria other than survival time, and parameters of neutron RBE; energy distributions from different radiations in relation to biological damage; dose-effect relations on cellular units; the roles played by chromosomes or nuclear volume and chromosome number in determining the relative radiosensitivity of higher plants; heat as a modifying factor in enzyme inactivation by ionizing radiations; and analysis of the effects of high LET radiation on various strains of cells. (H.M.G.)

41235 CHROMOSOME ABERRATION IN HUMAN BONE MARROW AS DIAGNOSTIC FOR RADIATION INJURY. Irene Boll (Städtische Krankenhauses Neukölln, Berlin). p.341-5 of "Radio-Isotopes in der Hämatologie. I. Internationales Symposion." Stuttgart, Friedrich-Karl Schattauer-Verlag, 1963. (In German)

Chromosome aberrations, induced in bone marrow cultures by radiation doses of 400 R, were studied with a phase contrast microscope. A chromosome break was observed during division. However, no diagnostic significance with respect to radiation damage was found in the comparison of irradiated and non-irradiated cultures. (J.S.R.)

41236 BLOOD SAMPLE STUDIES OF LABORERS EXPOSED TO IONIZING RADIATION. J. F. Coster (Rijks Instituut voor de Volksgezondheid, Utrecht). p.399-408 of "Radio-Isotope in der Hämatologie. I. Internationales Symposion." Stuttgart, Friedrich-Karl Schattauer-Verlag, 1963. (In German)

The results and problems resulting from the yearly examination of blood samples from all persons working with radiation are summarized. The effects of storage and preservation of the blood samples on the counting of erythrocytes, leukocytes, thrombocytes, and hemoglobin were determined. The deviations of the blood measurements were outlined. Comparative measurements were carried out at different laboratories in order to decentralize the blood studies. The counting results obtained on 3059 persons were tabulated. (J.S.R.)

41237 HEMATOLOGICAL DIAGNOSTICS OF LATENT RADIATION INJURY. K. Damminger and E. H. Graul (Universität, Marburg, Ger.). p.409-18 of "Radio-Isotope in der Hämatologie. I. Internationales Symposion." Stuttgart, Friedrich-Karl Schattauer-Verlag, 1963. (In German)

The utilization of the peripheral blood picture for the early diagnosis of latent radiation injury was investigated. The characteristics that a biological individual dosimeter must exhibit in order to indicate latent injury were tabulated, and the body systems that could be used were given. The reasons for the selection of the functional behavior of the peripheral blood as the indicator were discussed. To determine its efficiency the peripheral blood picture after treatment with ^{32}P at a dose of 0.07 mc/kg was determined. The results showed that this method had a limited utility. (J.S.R.)

41238 BONE MARROW FUNCTION TESTING WITH PYREXAL IN DIAGNOSIS OF RADIOINDUCED BONE MARROW INJURY. F. Wendt, I. Heilmeyer, A. Irtel, V. Brenndorff, and W. Otte (Universität, Freiburg i. B.). p.419-23 of "Radio-Isotope in der Hämatologie. I. Internationales Symposion." Stuttgart, Friedrich-Karl Schattauer-Verlag, 1963. (In German)

When granulocytosis of the peripheral blood is produced by a bacterial irritant, the granulocytes in the blood originate essentially from the bone marrow reservoir. When the peripheral granulocyte concentration is still in the normal range, an irritant to a reduced reservoir would result in reduced granulocytosis. This hypothesis was tested on convalescents and patients undergoing radiotherapy by injecting pyrexal as a bacterial irritant. The results showed that granulocytopenia occurred more frequently in irradiated persons than in convalescing persons. The dose range and time point after radiation at which bone marrow insufficiency occurred was investigated on rabbits. No practical results were obtained. However, the test did indicate the possibility of detecting bone marrow insufficiency in the presence of still normal granulocyte concentration as a step in a complete diagnosis. (J.S.R.)

41239 BONE MARROW CHANGES IN THE COURSE OF RADIOTHERAPY IN THE MORPHOLOGICAL AND ELECTRON-OPTICAL VIEW. B. Choné (Universität, Heidelberg). p.425-43 of "Radio-Isotope in der Hämatologie. I. Internationales Symposion." Stuttgart, Friedrich-Karl Schattauer-Verlag, 1963. (In French)

Time-stepped bone marrow studies in the field region were carried out on 110 carcinoma patients during radiotherapy with a ^{60}Co unit, and the studies were differentiated morphologically. As a reference basis, the bone marrow local dose was used. The possibility of an extensive quantitative detection of the local structure changes therefore existed. The evaluation and interpretation were made with the inclusion of mitosis and ^{3}H-thymidine labeling indices and supplemented by histological parallels. Some electron-optical illustration at the time of the early phase of bone marrow damage (1 to 3 hrs after irradiation), which cannot be detected by light microscopy, were presented. (tr-auth)

41240 IMPORTANCE OF THE SPLEEN IN RADIATION BURDEN. H.-J. Melching and O. Messerschmidt (Universität, Freiburg i. B.). p.463-70 of "Radio-Isotope in der Hämatologie. I. Internationales Symposion." Stuttgart, Friedrich-Karl Schattauer-Verlag, 1963. (In German)

The significance of the spleen in the reaction of the body to irradiation was reviewed on the basis of a bibliographic study. The effects of radiation on the taurine elimination were reported for normal and splenectomized mice. Possible mechanisms for the various processes observed were discussed. (J.S.R.)

Radiation Effects Therapy and Countermeasures

41241 (HW-80500(p.44-6)) ATTEMPTS TO REMOVE INHALED PLUTONIUM. E. G. Tombropoulos, C. E. Breckinridge, Jr., W. J. Bair, and K. E. McDonald (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Diethylenetriaminepentaacetate (DTPA) decreased the total body burden of Pu but not the amount retained in the lung after plutonium nitrate inhalation by rats. Attempts to remove Pu after the inhalation of PuO$_2$ were unsuccessful. Drugs that increased mucus secretion tend to reduce the clearance of PuO$_2$. (auth)

41242 (HW-80500(p.47-9)) EFFECT OF THE FORM OF INHALED CERIUM DIOXIDE ON ITS REMOVAL BY DTPA. E. G. Tombropoulos (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Properties of inhaled CeO$_2$ associated with the method of its formation influence the effectiveness of DTPA as a clearing agent in the lungs of dogs. (C.H.)

41243 (FTD-TT-64-892(p.217-31)) EFFECTIVENESS OF PHARMACOCHEMICAL PROTECTION IN GAMMA IRRADIATION AND IRRADIATION BY PROTONS WITH ENERGIES OF 660 AND 120 Mev. V. S. Shashkov, P. P. Saksonov, V. V. Antipov, V. S. Morozov, G. F. Murin, B. L. Razgovorov, N. N. Suvorov, V. M. Fedoseev (Fedoseyev). Translated from Komich. Issled., 2: 641-7(July-Aug. 1964).

The comparative effects of gamma rays from ^{60}Co and 660- and 120-Mev protons were studied in experiments on 1360 white mice. At a γ-ray dose rate of 364 R/min, the $LD_{100/30}$ came to 850 R (720 rad). On irradiation in a pulsed beam of 660-Mev protons (dose rate 600 to 700 rad/min), the $LD_{100/30}$ amounted to ~1178 rad. Cystamine (150 mg/kg), aminoethylisothiuronium (150 mg/kg), serotonin (50 mg/kg), and 5-methoxytryptamine (75 mg/kg), injected intra-abdominally 10 to 15 min before γ or proton irradiation, protected 50 to 80% of the animals from death. The protective effects of tryptamine and 5-hydroxtryptophane came to 20 to 25%. The relative biological effectiveness of 660-Mev protons as compared to ^{60}Co γ rays is 0.75 with respect to the LD_{50} for mice, and 0.73 with respect to the LD_{100}. (auth)

41244 CLINICAL PECULIARITIES OF ACUTE RADIATION SICKNESS IN MONKEYS TREATED WITH BCG. N. V. Raeva, N. N. Klemparskaya, and I. N. Usacheva. Med. Radiol., 9: No. 7, 37-45(July 1964). (In Russian)

Vaccination with BCG 34 days before exposure to γ radiation prolonged the life of monkeys and reduced the severe manifestations (especially hemorrhagic diathesis) of acute sickness. Vaccination with BCG 21 days before exposure, followed by chemical therapy, results in a high percentage of survival, prevented clinical manifestations of radiation sickness, and inhibited hemorrhagic diathesis and injuries to the hematopoietic system. Stomatic chemical treatments only resulted in a high percentage of survival in comparison to those treated only by vaccination, however, the treatments did not inhibit the manifestations of the acute radiation sickness. (R.V.J.)

41245 FOUNDATIONS OF TREATMENT OF SKIN REACTION TO RADIATION. K. H. Kaercher and H. Kleinart (Universität, Heidelberg). Med. Welt, No. 6, 315-18 (Feb. 9, 1963). (In German)

A salve with an oil-in-water emulsion base that contains 1,4-dimethyl-7-isopropyl azulene was developed for treatment of exudative inflammatory reactions of skin to radiation. The azulene has an antiphologistic effect which can be exerted effectively because of its water solubility. The aqueous components of the base also help to conduct the heat away and to provide evaporative cooling. The fatty components soften the skin, and prevent drying and adherence of the dressing to the skin. Antibiotics are not used because of the possibility of sensitization. Use of mucilaginous salves have no advantages over the use of powders for burns from x radiation or radiation from fast electrons. If a disinfectant is added to the salve, it may produce an exacerbation of the skin lesion that cannot be controlled by hydrocortisone. Probably, prompt treatment with a mucilaginous salve that contains hydrocortisone can alleviate the skin reaction to radiation somewhat, but the dynamics of the skin reaction is not altered, and there may be tension, dryness, and crust formation. Probably the best treatment scheme is a combination of first, powder, then in the exudative stages, moist oil-base dressings, and later, the recently compounded emulsified salve that contains azulene, as a final treatment. This treatment scheme is suited to the functional state of the irradiated skin, leads to more rapid freedom from pain, ensures healing without implications, and is nonirritating, so that iatrogenic injuries do not develop. The effectiveness of these procedures and the assurance that some satisfactory results can be obtained argue directly against most experimentation, since there is a limit to what is possible. (BBB)

41246 SHORTENING OF THE SPAN OF LIFE OF RATS BY 'MYLERAN.' A. Dunjic (Universite Louvain, Belg.). Nature, 203: 887-8(Aug. 22, 1964).

The relation between the reduction of lifespan in rats and the dose of the radiomimetic agent myleran is reported. Results indicate that the mean, median, and maximal lifespans at various dose-levels are inversely related to the dose of the drug. When bone marrow transfusions were given at 1, 3, or 5 days after administration of myleran, observed values for the mean lifespan were not significantly different from control values. Comparison of $LD_{50/30}$ doses of whole-body irradiation and myleran showed that ionizing radiation was apparently a more potent agent for reducing lifespan. Routine autopsies of the rats showed the presence of lens cataracts and testis atrophies with incidence rate and degree in proportion to myleran dose. (H.M.G.)

41247 QUANTITATIVE RELATIONS BETWEEN DOSES OF CHEMICAL PROTECTIVE AGENTS AND DOSES OF X-IRRADIATION. R. Koch and I. Seiter (Universität, Freiburg i. B.). Nature, 203: 984-5(Aug. 29, 1964).

Differences in radioprotective effects of radical-quenching substances and substances that act on the basis of their pharmacodynamic activity were studied in x-irradiated mice given either cysteamine or histamine. In animals protected with cysteamine, an increase in cysteamine dose resulted in an increase of protective effect, whereas in those given histamine there was no growing increase rate. The lack of increasing protective action of histamine is explained on the basis that the pharmacodynamic action of 0.5 to 5.0 mg histamine was sufficient to produce optimal protective action for all radiation doses. (H.M.G.)

41248 POST-IRRADIATION CASTRATION OF THE MALE AND ENHANCED SURVIVAL. Roberts Rugh, Lily Skaredoff, and Csilla Makay (Columbia Univ., New York). Proc. Soc. Exptl. Biol. Med., 116: 1110-14(Aug.-Sept. 1964).

Male mice of the ICR and CF1 strains were x-irradiated to the LD/50/30 range and some were castrated in order to determine whether the loss of testosterone might alter survival. In both strains, post-irradiation castration (within 30 minutes) did indeed increase statistically the survival of the mice. A delay in castration of 24 hours after irradiation (of the CF1 males) increased survival chances, and estradiol (at that time) further improved survival probability. However, estradiol benzoate given immediately after x-irradiation and castration had an unfavorable effect. It is suggested that the mechanism of effect of castration may be in the encouragement of lymphocyte recovery, thus reducing the usual effects of lymphopenia attendant upon x irradiation. Since the survival improvement by post-irradiation castration is statistically significant, but amounts to only about 30%, its efficacy lies near the LD/100/30 range, and not higher. Possibly in combination with bone marrow the benefits would be additive, or even synergistic. (auth)

41249 THE TREATMENT OF RADIATION-INDUCED INTESTINAL REACTIONS (2. COMMUNICATION AND END). W. Schmidt (Medizinischen Akademie, Magdeburg, Ger.) and K. Neumeister. Radiobiol. Radiotherap., 5: 435-40(1964). (In German)

The influence the intestinal radiation reactions by prophylactical supply of physiological intestinal flora (B. coli, L. acidophilus, L. bifidus) is reported. The diarrhpeic frequency in highly dosed abdominal irradiations may be reduced in such a way from 61.1 per cent (control group to 11.7 per cent. The best results of treatment showed the combined supply of several intestinal germs (B. coli with L. acidophilus) or the combination of B. coli with pancreatic ferments. The results are statistically significant. (auth)

41250 INVESTIGATIONS OF THE EFFECT OF PROTOPORPHYRIN ON THE RADIOSENSITIVITY OF LYMPHOSARCOMA-ASCITES CELLS AND WHOLE-BODY IRRADIATED C 57 bl/6-MICE. E. Magdon (Robert-Rossle-Klinik, Berlin). Radiobiol. Radiotherap., 5: 501-6(1964). (In German)

The investigations showed the protoporphyrin in dependence on the period between application and irradiation when applied before irradiation to have a radioactive effect on the survival rate of whole-body irradiated C 57 bl/6-mice and on the growth of lymphosarcoma-ascites cells. An application after irradiation remained without influence on the radiation effect for the survival time as well as for the growth of ascites cells. As a possible mechanism of radioprotective effect the protoporphyrin is supposed to prevent the peroxidation of molecular radicals with radiation-induced radicals of biologically significant molecules in a competing reaction with the available oxygen. The possible reactions of the resulting radical of protoporphyrin are represented. (auth)

41251 INVESTIGATION OF THE RADIOPROTECTIVE EFFECTS OF THE CALLICREIN INACTIVATOR TRASYLOL IN ANIMAL EXPERIMENTS. Karl Heinz Kaercher and Helena Toslu Kato (Universität, Heidelberg). Strahlentherapie, 124: 536-9(Aug. 1964). (In German)

The influence of the kallikrein inactivator Trasylol upon the death rate of white inbred rats after whole-body irradiation is reported. Enzyme investigations in serum and intestine, concerning the behavior of malate dehydrogenase as well as leucine aminopeptidase, were done. An obvious effect of Trasylol upon the radiation induced changes could not be detected. Clinical investigations did not show a therapeutic effect of this substance either. These results agree well with those obtained by Pabst. (auth)

41252 CLINICAL EXPERIENCE WITH THE EFFECTS OF ORAL APPLICATION OF N-ACETYLHOMOCYSTEINE THIOLACTONE IN THE INTESTINAL REACTION FROM RADIOTHERAPY OF GYNECOLOGICAL CARCINOMAS. Hans-Guenther Friebel (Universität, Hamburg). Strahlentherapie, 124: 540-6(Aug. 1964). (In German)

Clinical experiences obtained with oral administration of homocysteinethiolaktone in combination with cysteine and fructose during radiation therapy of 59 gynecological carcinomas are reported. A group of 84 carcinomas not treated with these radiation protective substances were used for comparison. Using the statistically significant results it might be concluded, that the combined drugs mentioned above have a beneficial effect upon the intestinal reaction during irradiation of gynecological carcinomas. (auth)

41253 LATE CHANGES AFTER LETHAL X-RAY WHOLE-BODY IRRADIATION OF WHITE MICE AFTER APPLICATION OF RADIOPROTECTIVE SUBSTANCES. Liebknecht Dimitrov (Max-Planck-Institut für Biophysik, Frankfurt am Main). Strahlentherapie, 124: 599-616(Aug. 1964). (In German)

In order to obtain a protective effect, serotonin has to be present in the tissues and must be administered immediately before irradiation. The dose cannot exceed 800 R. Combined administration of serotonin with MEA and AET increases the resistance of white mice to x irradiation with a dose above 800 R. A protective effect was also observed with 1000 R, and even with 1100 R. The dynamic observation of the body weight 6 to 7 months after irradiation with a lethal x-ray dose, pathomorphologic controls, studies using DNS-synthesis by incorporation of radiothymidine and radioadenine in the late period after x-ray total body irradiation show that the tested protective substance in a large number of animals did not guarantee a complete recovery from the radiation insult. Serotonin alone produced more deviations. Animals treated with the combination serotonin-AET-MEA after lethal irradiation showed only a weak tendency to have a decreased resistance towards tiring. The use of the radiation protective substance serotonin and its combination with AET and MEA does not change the necessity of therapeutic measures in the postirradiation period. (auth)

41254 ON CONTROL OF RADIOENTERITIS BY THE ADMINISTRATION OF LIVING LACTOBACILLI IN GYNECOLOGICAL CARCINOMA PATIENTS. Urs Adler (Universität, Basel). Therap. Umschau, 19: 283-5(July 1962). (In German)

A total of 33 female patients were treated with Ribolac, a powder consisting of living lactobacilli and a vitamin supplement. Of thise patients 10 had received radiation treatment from 1 to 5 yr previously. The patients received the Ribolac either from the beginning of radiation treatment or afterwards upon the appearance of symptoms of tenesmus, cramps, or generalized incapacity. These patients were compared with a control group of 50 patients treated with Ra or x ray alone, but who did not receive Ribolac. In the treated group who received Ribolac prophylactically, four had no intestinal symptoms at all, seven had minor symptoms, and two had such severe symptoms that radiation treatment had to be terminated. Of the patients treated with Ribolac only when symptoms appeared, four became completely symptom free, while only one of six with severe symptoms failed to respond to the Ribolac treatment. When the Ra radiation treatment was stopped, this patient responded favorably to the Ribolac. Comparing the total number of treated patients with the control group, Ribolac caused a definite improvement in response to the Ra radiation treatment. Of the patients treated with Ribolac, only 15% did not show improvement or complete freedom from radioinduced enteritis. In the control group the corresponding figure was 32%. Even though the number of cases is relatively small, these differences are significant. For this reason Ribolac treatment is recommended for use with intensive radiation therapy of the abdominal region and especially in gynecological practice. (BBB)

41255 ACUTE BLOOD-LETTING DURING RADIATION SICKNESS. A. A. Beisebaev. Vestn. Akad. Nauk Kaz. SSR, No. 5, 48-53(May 1964). (In Russian)

Effects of blood letting on the hematopoietic system and the course of acute radiation sickness were studied using 169 rabbits. Blood letting (16.5 ml per kg of weight) in control rabbits stimulated hemopoiesis. Blood letting 2 hr after exposure to 600 R eliminated leukocytosis, did not affect leukopenia, and stimulated erythropoietic functions. Blood letting at later periods (3 and 9 days after exposure to 600 R) aggravated the sickness, increased fatality, and shortened the life span. The animals suffered from acute anemia caused by suppressed bone marrow function and lack of compensatory mechanisms. (R.V.J.)

41256 CHANGES IN THE PERMEABILITY OF THE BLOOD-BRAIN BARRIER IN RADIATION ILLNESS. N. N. Aleksandrov, S. V. Zakharenko, and V. G. Koznarev. Zdravookh. Belorussk., 9: 49-60(1962). (In Russian)

Experiments indicated a strongly stimulated permeability to antibiotics injected into the spinal fluid. Penicillin and streptomycin introduced into the subarachnoid space during acute sickness enter the blood stream much faster than under normal conditions. It is suggested that during cranial and brain injuries combined with acute radiation sickness, regular intramuscular injections of streptomycin and especially penicillin are even more effective than subarachnoid injection of permissible once-a-day doses. The stimulated permeability of the hematoencephalic barrier and the danger of considerable hemorrhage at subarachnoid punctures during acute radiation sickness suggest certain limitations to intralumbar punctures. During initial or silent periods of radiation sickness intramuscular injections of penicillin and intralumbar introduction of streptomycin remain very desirable. However, during acute stages the subarachnoid injections are desirable only in the event of heavy infection of the brain and its meninx. (R.V.J.)

Radiation Hazards and Protection

41257 (HW-80500(p.113-15)) REMOVAL OF INTERNALLY DEPOSITED PLUTONIUM. J. E. Ballou and J. L. Palotay (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Comparative tests indicate prompt oral treatment with triethylenetetraminehexaacetic acid (TTHA) is more effective and less toxic than equivalent treatment with diethylenetriaminepentaacetic acid (DTPA) or the pentaethylester of DTPA for the removal of internally deposited ^{239}Pu in rats. The optimum oral dose of TTHA is 3 mM/kg. Prompt or delayed intravenous administration of DTPA in suspensions of India ink or zirconium colloid was no more effective than DTPA alone. (auth)

41258 (TID-20989) IN IMMUNOGENETIC STUDY OF THE MECHANISMS OF PROTECTION AGAINST RADIATION DEATH BY TREATMENT WITH HAEMATOPOIETIC TISSUES. Research Report, December 1, 1963–July 31, 1964. Gustave Hoecker (Chile. Universidad, Santiago). Contract AT(30-1)-2488. 11p.

Progress is reported in studies of immune reactions involved in the protection of mice and rats against lethal radiation doses by treatment with injections of hematopoietic tissues. Data are included from studies on cyclic variation in radiosensitivity of mice and rats; effects of dose fractionation on radiosensitivity; effect of the state of erythropoiesis at the moment of irradiation on radiosensitivity; the effects of irradiation on response of rats to erythropoietin; strain and sex differences in the radiosensitivity of erythropoietic tissues in mice; the location of transplantation antigens in subcellular fractions, their molecular associations, and their role in cell metabolism; and sexual differences in heteroagglutinins produced in mice against human red blood cells. (C.H.)

41259 RADIATION HAZARDS RESULTING FROM CLINICAL USE OF RADIO-IODINE. R. Sear (London Hospital). Acta Radiol., Therapy, Phys., Biol. (N. S.), 2: 263-72(Aug. 1964).

The relative hazards to adults, children and foetal thyroids from external γ irradiation and internal irradiation from ingested radioiodine are examined in the light of authoritative statements of maximum permissible dose. The dose likely to be received bý persons, other than patients receiving therapy doses, through the clinical use of radioiodine, is examined critically in relation to these hazards. It is seen that although it is quite possible to avoid any undue risk to nurses and to the general public by careful control of conditions and the use of modern equipment current practice leaves much to be desired in some cases. (auth)

41260 AN ATTEMPT AT INFLUENCING LOCAL IRRADIATION REACTIONS WITH RUTIN. A PRELIMINARY REPORT. J. Ďurkovský. Bratislav. Lekarske Listy, 44: 104-9(1964).

In a group of 10 patients with carcinoma of the larynx, Grade I or II, the proprietary preparation Birutan forte (rutin) was applied with the aim of alleviating local inflammatory reactions due to radiotherapy. During the entire course of x ray treatment the daily dose of 600 mg. Birutan was applied intramuscularly. By the application of Birutan it was possible to attenuate radiation skin reactions, but the effect was less pronounced than the results described by other authors. No effect of Birutan application was observed on the inflammatory post-irradiation reactions of mucous membranes. (Excerpta Med., Sect. XXIII, 1: (Aug. 1964))

41261 PROBLEMS OF GONAD EXPOSURE IN RADIOTHERAPY OF ANGIOMAS IN CHILDREN. DOSIMETRIC STUDY DURING RADIATION TREATMENT WITH THE VAN DER PLAATS APPARATUS. V. Bek and V. Michal (Charles Univ., Prague). Cesk. Radiol., 18: 11-19(1964).

The gonad radiation dose in small children of both sexes treated with the van der Plaats apparatus for contact irradiation was measured in water phantoms. In both sexes, the gonad doses changed with the distance of the radiation source from the gonads, with changes of size of the irradiated field, with different qualities of radiation, with changes of direction of the primary ray pencil, and in relation to shielding of the irradiated object. Even in radiation treatment with these soft x rays (50 Kv) in the area of the lower half of the trunk and proximal parts of the lower extremities, the gonad doses reach significant or even quite undesirable levels with application of doses which are used in practice during radiation treatment of angiomas with this method. On the other hand, when radiation treatment was applied in the area of the head the gonad loading was negligible. The authors propose some principles for actinotherapy of angiomas in children from the standpoint of genetic effects of radiation. In radiation treatment with soft x rays (Dermopan, van der Plaats, Chaoul's apparatus) it is always necessary to consider carefully all factors which determine the degree of gonad loading with dispersed radiation. At present, it is not justified to use external γ-radiation (radium or artificial γ-radiators) in the radiation treatment of angiomas in children. Implantation of γ-radiators ought to be used only in angiomas in which other therapeutical methods, including surgery, give unsatisfactory results. (Excerpta Med., Sect. XXIII, 1: (Aug. 1964))

41262 CLINICAL REMARKS ON PROCTITIS DUE TO IRRADIATION AND ON THE THERAPEUTIC POSSIBILITY OF A NEW CORTISONE-LIKE DRUG WITH LOCAL ACTION. G. Fontana-Donatelli and F. D'Ambrosio (Università, Milan). Clin. Ostet, Ginecol., 65: 716-27(1964).

After a short study of the modern aspects of irradiation proctitis, results of clinical experiments carried out with local application of a new steroid compound are presented. Forty patients submitted to radium therapy for carcinoma of the uterine cervix were treated. In all cases a proctitic syndrome classifiable according to its characteristics of symptoms as first or second stage of the classifical schemes had appeared within a variable period from a few days to 2 or 3 mo. after termination of the radiation treatment. The preparation was applied locally 2 or 3 times per day for 10 to 30 days. In 50% of cases the therapeutic effect was good with complete remission of the symptomatology, in 30% there was only a partial regression of the symptoms, whereas in the remaining 20% no appreciable improvement could be recorded. The usefulness of this drug, particularly in the very early and light forms of radiation proctitis, is emphasized. (Excerpta Med., Sect. XXIII, 1: (Aug. 1964))

41263 DETERMINATION OF THE TOTAL DOSE ABSORBED IN EXTERNAL AND INTERNAL RADIATION. G. M. Obaturov. Gigiena i Sanit., 29: No. 6, 59-63(June 1964). (In Russian)

A method is suggested for determining absorbed doses of γ, β, and neutron radiation on the basis of integral flux. A table is given of coefficient for various tissues. (R.V.J.)

41264 LABORATORY SUPPORT FOR AN X-RAY INSPECTION PROGRAM. Hanson Blatz (New York City Dept. of Health). Health Phys., 10: 643-9(Sept. 1964).

An attempt was made to demonstrate that the standards now being used in the United States for x-ray inspections are far from satisfactory in terms of validity, scope and completeness. The tools and instruments available to collect the necessary data are, for the most part, inadequate and inappropriate since they were almost all designed for other purposes. These deficiencies can be resolved only by a vigorous and extensive program of research and experimentation to improve the standards and develop new instruments and inspection techniques. Such a program is beyond the scope of local health agencies without substantial and well coordinated outside support. This situation has existed in spite of the knowledge for many years that excessive exposure of the population to radiation from x-ray equipment far exceeds that from all other man-made sources including fallout, about which so much research effort has been exerted. (auth)

41265 EFFECT OF CHEMICAL PROTECTANTS AGAINST RADIATION INJURIES BY MEANS OF TISSUE CULTURE TECHNIQUE. I. EVALUATION OF THE RADIO-PROTECTIVE ACTION OF CYSTEINE. Masahiko Ohira, Yoshio Mochizuki, Takeshi Kuroda, Toshiyuki Tamura, and Hifumi Honnami (Okayama Univ., Japan). Igaku To Seibutsugaku, 61: No. 1, 24-8(Oct. 5, 1961). (In Japanese)

41266 THE HAZARDS AND INJURIOUS EFFECTS OF MODERN ROENTGENOLOGIC DIAGNOSIS AND RADIOTHERAPY. Th. Hornykiewytsch and G. Bargon (Universität, Giessen, Ger.). Internist, 3: 487-98(Aug. 1962). (In German)

Various radiographic methods are discussed in reference to hazards. Emphasis is given to dangers arising from the use of contrast materials, especially barium and iodine. Factors influencing dosimetry in diagnostic radiography are considered, and radiodiagnostic exposure is compared for several countries. (H.M.G.)

41267 HOW CAN THE PHYSICIAN LESSEN A HAZARD TO OFFSPRING? W. Lenz (Universität, Hamburg). Med. Welt, 48: 2554-8(Dec. 1, 1962). (In German)

Studies are cited that indicate x radiation is not etiologically significant in birth defects. However, it is pointed out that these and other similar negative results should not be taken to indicate that ionizing radiation is not genetically injurious to humans. The position is taken that there is no threshold dose for mutagenesis, and the dose rate is identified as the most important factor influencing genetic radiation damage. Radiosensitivity differences between male and female gametes are discussed. (TCO)

41268 USE OF AN ERYTHROCYTIC RADIOMIMETIC MODEL FOR THE STUDY OF POTENTIAL RADIOPROTECTORS OF THE THIAZOLIDINE GROUP. M. L. Kakushkina, Yu. B. Kudryashov, F. Yu. Rachinskii, and N. G. Dmitrieva. Radiobiologiya, 4: 632-6(1964). (In Russian)

Thiazolidine belongs to a group of potential radiation protectors which are activated by chemical transformations, in particular by hydrolysis which releases the thiol group. The protective properties of these compounds were studied by means of the radiomimetic erythrocytic model, proposed earlier by the authors (Doklady Akad. Nauk SSSR, 149, 973(1963)). The $0.02\underline{M}$ solution of the radioprotectors being tested in physiological solution was mixed with the erythrocytes. The compounds tested included β-mercapto ethylamine, 2-methyl thiazolidine, 2-propyl thiazolidine, 2,2-dimethyl thiazolidine, 2-methyl-2-phenyl thiazolidine, 2-cyclopentamethylene thiazolidine, 2-methyl-2-acetoethoxy thiazolidine, 2-rhamnosyl thiazolidine, 2-glucosyl thiazolidine, 2-pyridyl thiazolidine, 2-methyl thiazolidine, 2-methylcarboethoxythiazolidine, and 2-methyl-2-propoxy thiazolidine. The tests indicated that the compounds exert a protective action against γ-radiation and the radiomimetic effect of oxidized oleic acid. This property is due to the substitution of H atoms in the 2-position by various radicals. The radiomimetic model may be used for the study of protective properties and for selecting aminothiol type radioprotective agents or compounds capable of forming aminothiols by chemical transformation. (TTT)

41269 THE PROTECTIVE EFFECT OF MELAMIN IN THE CASE OF THE IRRADIATION OF MICE. G. D. Berdyshev (Inst. of Cytology and Genetics, Academy of Sciences, Novosibirsk, Siberia). Radiobiologiya, 4: 644-5(1964). (In Russian)

The aromatic polymer melamin formed by the oxidation of the amino acid thyrosin, was investigated as a potential radiation protector. White mice were used for the tests which involved the intraperitoneal injection of melamin in nontoxic amounts. The animals were subjected to whole-body irradiation of 800 R at a rate of 50 R/min. The results indicated that melamin exerts a marked protective action. Administration after the exposure did not protect the animals. Repeated injections were also found to provide protection. The actual mechanism of the protective action is not yet fully clarified; it might be due to the transfer of energy from the protein molecules excited by radiation to the pigment, thus scattering the energy in the form of low-energy quanta. (TTT)

41270 PROTECTION OF THE REGENERATIVE PROCESS IN THE EPITHELIUM OF THE CORNEA OF IRRADIATED MICE BY β-MERCAPTO ETHYLAMINE. L. M. Rozhdestvenskii (Inst. of Biophysics, Moscow). Radiobiologiya, 4: 582-8(1964). (In Russian)

Tests for the evaluation of chemical radiation protectors, based on the mitotic index and the number of cells with chromosome aberrations, is a valid one because disturbance in the tissue regeneration is an important link in the pathogenic chain of acute radiation sickness. This problem was further examined by exposing white mice to 600 R of whole-body γ radiation at a dose rate of 284 R/minute; one of the groups was injected intraperitoneally 8 to 11 hours before the irradiation with 0.1 ml of a 3% solution of β-mercapto ethylamine, while the second group was similarly treated with 0.1 ml of physiological solution. Some of the animals were used to determine the 30-day survival rate; others were killed 1, 3, 4, 5, 7, 10, and 15 days after exposure. The number of dividing cells and cells with chromosome aberration in the cornea were determined by means of the usually employed tests. The results revealed that the injection reduced the number of cells with chromosome aberrations in the epithelium of the cornea but it did not affect the mitotic index. The number of cells exhibiting chromosome aberrations may be used for the preliminary estimation of the protective action and for the determination of the optimum period for administering the protecting agent. (TTT)

41271 THE PROTECTIVE EFFECT OF β-MERCAPTO PROPYLAMINE AGAINST TRAUMA-ENHANCED RADIATION INJURY OF THE CRYSTALLINE LENS. V. A. Golichenkov, V. V. Popov, E. B. Vsevolodov, and V. A. Kozlov (Moscow State Univ.). Radiobiologiya, 4: 587-93(1964). (In Russian)

One of the authors found earlier (Doklady Akad Nauk SSSR 137: 192(1961); ibid. 143: 444(1962)) that minor trauma of the irradiated crystalline lens accelerates the development of radiation cataract. An attempt was made to prevent this surgical effect by using a radiation protective agent and to use this effect as a rapid biological model for evaluating radiation protectors. Mature *Rana temporaria*, irradiated at 15 kR, were used for the experiments, with the surgical effect represented by a cut in the right eye while the left eye served as control. β-mercapto propylamine (MPA) was used as the protective compound. The results showed that parenterally or locally administered MPA at a dose rate of 400 mg/kg does not affect the sight of the frog; however, used jointly with exposure to x radiation, this dose interferes with the vision and may even cause blindness. The compound weakens the surgical response to such an extent that the trauma does not accelerate at all the development of the radiation cataract. The method may be used for the preliminary evaluation of potential radiation protectors. (TTT)

41272 THE ROLE OF THE SUPRARENAL GLANDS IN THE REACTION TO IRRADIATION UNDER THE APPLICATION OF CHEMICAL RADIATION PROTECTORS. V. P. Korotkova and A. M. Stashkov (Inst. of Experimental Medicine, Leningrad). Radiobiologiya, 4: 594-8(1964). (In Russian)

The radio protective effect of the suprarenal glands has been verified repeatedly. Secondary symptoms appeared in organs far removed from the place of irradiation, but removal of the suprarenal glands before irradiation prevented the appearance of these symptoms. The mechanism of this chemical prophylactic action was investigated. Both suprarenal glands of male mice and rats were removed and some of the animals were treated with radiation protectors, such as antiphein and mercamine before exposing them to 600, 700, or 800 R of whole-body x radiation 2, 3, 4, 5, 6, 7, 8, or 30 days after the operation. The survival rate and the life span were used as the chief criteria for judging the effect. It was found that irradiation 2, 8, and 13 days after adrenalectomy results in practically identical survival rate. The average life span of the operated mice was 1.5 times and of the rats 2 to 2.5 times lower than that of the nonoperated animals, indicating an incomplete compensation of the suprarenal function. Development of the intestinal syndrome in some of the rats resulted in their death 3 to 5 days after the operation. The protective action of antiphein was somewhat lowered in the case of the operated animals. The results indicated that the suprarenal glands participate in the general protective reactions of the organisms treated with radiation protective agents before irradiation. The fact that both antiphein and mercamine exhibited protective action in the operated animals indicates that the protective effect is indirect. It is concluded that radiation protectors not only affect the radiochemical processes but also stimulate the physiological protective mechanisms. (TTT)

41273 DECONTAMINATION OF MILK FROM RADIOACTIVE ANIONIC INGREDIENTS. Gopala K. Murthy, James E. Gilchrist, and Jeptha E. Campbell, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,148,989. Sept. 15, 1964.

A process was developed for removing iodine from milk without changing its chloride, phosphate, and citrate concentrations by passing the milk over a strong-base quaternary ammonium-type anion exchange resin, in its chloride form, that was pretreated with a solution having the same pH value as the milk to be treated, a chloride concentration from 3.9 to 4.1 times that of the milk, a phosphate concentration from 4.5 to 4.7 times that of the milk, and a citrate from 20 to 21 times that of the milk and by subsequent washing with water. (AEC)

Radiotherapy and Radiodiagnosis

41274 (HW-80500(p.167-72)) RADIORENOGRAMS IN SHEEP AND MINIATURE SWINE. R. O. McClellan and H. A. Ragan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A technique is described for evaluating kidney function in sheep and miniature swine by detecting with external monitors the uptake and disappearance of intravenously administered Na iodohippurate-^{131}I. The renogram in control swine was characterized by a three-segment curve similar to that noted in other species and was developed as a base for evaluating induced kidney damage. (auth)

41275 (HW-80500(p.173-6)) DETERMINATION OF GASTROLITH DEVELOPMENT IN CRAYFISH. J. M. Dean (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

By removing the site of release of the molt-inhibiting hormone, molting can be induced in crayfish. This was done on one species of crayfish, *Pacifastacus trowbridgerii*, allowing determination of the length of the molt cycle and some of the physiological processes of the pre-molt, molt, and post-molt sequence. Utilizing radiography techniques permits determining the developmental stages of the gastrolith without killing the animal. (auth)

41276 (UCRL-10980) DEPTH DOSE IN TISSUE IRRADIATED BY PROTONS (thesis). Palmer G. Steward (California. Univ., Berkeley. Lawrence Radiation Lab.). July 30, 1964. Contract W-7405-eng-48. 83p.

A code has been developed for the depth-dose relation in spheres of tissue due to primary protons and to cascade, evaporation, and hydrogen elastically scattered secondary protons. Hydrogen elastically scattered protons are assumed to be emitted in the forward direction, as also, on the basis of Metropolis's calculations, are cascade protons. Evaporation protons are assumed to deposit their dose locally. It is shown that the dose rate at a depth d in a slab due to a normally incident parallel broad beam of protons is the same as the dose rate at the center of a sphere of radius d when an isotropic flux is incident upon the sphere. The depth-dose results are checked by experiments using 730-Mev protons, and compared with Monte Carlo calculations performed at Oak Ridge for 400-Mev protons. The results show that the depth-dose pattern varies widely with proton energy and sphere size. For certain intermediate proton energies, the primary protons cause a peak dose rate at a predictable depth in the sphere. The secondary proton dose rate increases with increasing incident proton energy, sphere size, and depth. Protons of 730 Mev cause a secondary proton dose at the center of a 2.5-cm-radius sphere which is 14% of the total dose, 35% for a 10-cm radius, and 48% for a 25-cm radius. (auth)

41277 TREATMENT OF MALIGNANT TESTICULAR TUMORS. A REPORT ON 355 PATIENTS. Gustaf Notter and Nils Erik Ranudd (Karolinska Sjukhuset, Stockholm). Acta Radiol., Therapy, Phys., Biol. (N.S.), 2: 273-301 (Aug. 1964).

The treatment of 355 malignant tumors of the testicles, about 60% of which were seminomas and 37% carcinomas, is reviewed. Orchiectomy and irradiation, combined in some instances with homolateral retroperitoneal lymphadenectomy, formed the standard treatment. The prognostic importance of hormonal factors, trauma and metastases, as well as some practical aspects of operation and irradiation, are discussed. (auth)

41278 RADIOACTIVE YTTRIUM 90. A REVIEW OF ITS PROPERTIES, BIOLOGICAL BEHAVIOR, AND CLINICAL USES. Leonard A. Walker (Aktiebolaget Atomenergi, Studsvik, Nyköping, Sweden). Acta Radiol., Therapy, Phys., Biol. (N.S.), 2: 302-14(Aug. 1964).

The clinical uses of ^{90}Y, especially therapeutic applications, are reviewed and discussed. This isotope offers certain advantages over gold 198 colloids and chromic phosphate ^{32}P. The distribution of ^{90}Y within the body can be modified by means of chelating agents, a technique which has widened its potential clinical applications. The use of ^{90}Y as a routine prophylactic measure after surgical removal of some intraperitoneal tumors appears promising and is especially worthy of more extensive clinical trial. (auth)

41279 THE USE OF ULTRAHARD RADIATION IN GYNECOLOGICAL RADIATION THERAPY. Friedhelm Oberheuser (Universität, Hamburg). Aerztl. Forsch., 17: 141-6(Mar. 10, 1963). (In German)

The ultrahard radiation (15.5 Mev) from the betatron is extremely valuable for treatment of pelvic tumors. The relatively high dose, sharp definition of the depth field, and the small differences in tissue absorption protect the bone and result in a very even series of isodose curves. Of 438 cases treated with this type of radiation the greatest number had carcinoma of the uterus. For this type of carcinoma x ray combined with Ra therapy is best. The Ra produces a high radiation field at the site of the primary tumor, but the steep dose decrease at the pelvic wall makes x-ray treatment necessary in order to include all possible areas of tumor infiltration. Radiation is carried out within two fields, lower abdominal and gluteal. The lower boundary of the abdominal field extends caudally to the border of the symphysis. The radiation is directed at an angle of 15° from the perpendicular toward the pelvis. In the gluteal field the beam is directed at an angle of 15° from the perpendicular in the cranial direction. The total dose administered from the Ra implant amounts to $\sim$4000 mg-hr, and the total dose of 15.5-Mev x rays given is 4600 R. From the Ra the dose at the pelvic wall is $\sim$100 R, but with the 15.5-Mev x radiation the total dose is increased to from 5000 to 8000 R. In a typical radiation series for uterine carcinoma Ra is administered at three separate times 10 days apart. The x radiation is given daily in single dosages of 200 R. On each radiation day both the abdominal and gluteal fields are irradiated. On the day before and the day after the Ra treatment the percutaneous radiation treatment is interrupted. Of 170 uterine carcinoma patients who were treated with conventional 200-kv x ray and Ra, 86% were alive after one yr, but 94% of those treated with ultrahard x ray were alive after one yr. The corresponding figures were 67 and 75%, 59 and 58%, 49 and 50%, and 48 and 80% for survival times of from two to five yr. (BBB)

41280 REGIONAL OXYGENATION AND IRRADIATION: HEAT AND NECK. J. T. Mallams, G. A. Balla, J. W. Finney, and B. L. Aronoff (Baylor Univ., Dallas). Arch. Otolaryngol., 79: 155-9(1964).

The intra-arterial infusion of solutions of hydrogen peroxide prior to and during irradiation in an attempt to improve the radiotherapeutic ratio was investigated. The results presented justify further extension of this study. Significant experience in intra-arterial techniques and meticulous coordinated control of the infusion therapy are essential to minimize complications in the head and neck group. Other applications of this approach, such as the intra-arterial infusion of chemotherapeutic agents and/or isotopes in conjunction with hydrogen peroxide, are discussed. (Excerpta Med., Sect. XXIII, 1: (Aug. 1964))

41281 SURVIVAL CURVES AND AUTOIMMUNITY AGAINST CANCER. Harold B. Hewitt (Mount Vernon Hospital, Northwood, Middx., Eng.). Brit. J. Radiol., 37: 714-15(Sept. 1964).

Past experiences and current proposals concerning the relation between radiation dose and effects on tumors at the cellular level are discussed. The discussion is focused on an evaluation of autoimmunity in cancer and implications of this for radiotherapy. The position is taken that a modification of the tumor's behavior in the host must be demonstrated before the term autoimmunity can be properly used, and further that such modification must be shown not to be directly attributable to externally applied therapy. (H.M.G.)

41282 SURVIVAL CURVES AND AUTOIMMUNITY AGAINST CANCER. T. R. Munro (Strangeways Research Lab., Cambridge, [Eng.]). Brit. J. Radiol., 37: 715-17 (Sept. 1964).

Evidence showing that the radiotherapeutic cure of cancer cannot be explained in terms of cell survival curves is reviewed. Although the theory of autoimmunity is advanced, it is emphasized that there is not yet conclusive evidence supporting it. The survival curve postulations of Hewitt are analyzed and refuted. (H.M.G.)

41283 COMBINED SYSTEMIC CHEMOTHERAPY AND CENTRAL NERVOUS SYSTEM IRRADIATION IN THE TREATMENT OF MICE WITH L1210 LEUKEMIA. Ralph E. Johnson (National Cancer Inst., Bethesda, Md.). Cancer Chemotherapy Rept., 31: 67-8(Sept. 1963).

The possibility was investigated that human central nervous system involvement by leukemia is subject to control by chemotherapeutic drugs of acceptable toxicity. Leukemia L1210 was inoculated intracranially into CDF$_1$ hybrid female mice. After inoculation the animals were randomized into the test groups, but no treatment was initiated until day 4 to permit the disease to become systemic. Combination therapy gave markedly improved results when compared to therapy with either drug or irradiation alone, resulting in a highly significant prolongation of survival. The combined treatment consisted of 150 mg/kg Cytoxan and 2-Mev electron irradiation of the cranium and spinal column at 500-rad doses. It is not felt, that clinical application of this approach is justified only if a high percentage of cures can be obtained experimentally in mice since the major forms of toxicity which limit effective treatment in mice are combatable clinically with antibiotics, blood transfusions, and other forms of supportive care. It is noted that although precise application of electron beam irradiation is somewhat difficult in mice, careful manipulation of this tool clinically could minimize irradiation of the vertebra and thereby significantly reduce therapeutic toxicity due to bone marrow depression. (BBB)

41284 USE OF OXYGEN CUSHION IN A SINGLE CONTACT IRRADIATION OF SKIN CARCINOMAS. Cesk. Radiol., 18: 40-3(1964).

A preliminary report is presented on a trial with a new therapeutic method in skin carcinomas using single-contact irradiation combined with previous infiltration of the tumor site with oxygen. This method was used in 77 patients with a total of 86 lesions. The method shortened considerably the duration of treatment, and its cosmetic results were good. Definite results could not be evaluated in view of the short observation period and small number of patients treated with this method. (Excerpta Med., Sect. XXIII, 1: (Aug. 1964))

41285 AFTER-CARE FOLLOWING CLINICAL CANCER THERAPY IN GYNECOLOGY. R. Kepp (Universität, Giessen, Ger.). Med. Monatschr., 17: 552-7(Sept. 1963). (In German)

The advisability of medically supervised after-care of women patients, having had malignant tumors of the reproductive organs treated by radiation and after having been discharged from the hospital, is discussed. The importance of a recuperative period free from the daily care and worries of the family is pointed out and the establishment of a nursing home for the care of women after hospital-stay is described. Disorders of the urinary and gastrointestinal tracts caused by radiotherapy are outlined. The various methods used to relieve these disorders are described in detail and the use of certain drugs such as Aristasept, Deltacortil, Desitin, and Mexaform S is discussed. It is suggested that hormones be used in cases of incurable cancer, because rapid growth of the cancer is often caused. (TCO)

41286 THE IMMEDIATE AND REMOTE SEQUELAE OF THERAPEUTIC RADIATION IN THE TREATMENT OF MILK-DUCT CARCINOMA. A. I. Strashinin (Central Scientific Research Inst. of Roentgen-Radiology, Ministry of Health, USSR). Med. Radiol., 9: No. 7, 18-20(July 1964). (In Russian)

The severity of the general radiation reaction was studied in 227 patients with milk-duct carcinoma. Subjective manifestations of the general radiation reaction in the form of nausea, weakness, and vertigo were encountered in 12 to 17 per cent of cases; irrespective of the course of treatment, they should not be the cause for discontinuing radium therapy. The most serious manifestation of the general radiation reaction was leukopenia, which when leukocytes were below 3,000 cells in one mm of blood occurred in 37 per cent of patients. Out of 227 patients in remote periods (4 to 12 years) after the end of radium therapy subject to examination were 45 patients. It was found that local radiation injuries were stable and directly related to the dose and method of radiation. No residual manifestations of the general radiation reaction were revealed at remote periods. (auth)

41287 LOW ENERGY BETA-RAY APPLICATOR. M. Zaduban (Safarik Univ., Kosice, Czechoslovakia). Neoplasma, 11: 103-9(1964).

The fabrication and uses of β-emitter applicators for surface irradiation therapy are discussed, and the advantages and disadvantages of some β-emitters (^{14}C, ^{35}S, ^{45}Ca, and ^{147}Pm) employed for this purpose are outlined. Utilization of cellulose derivatives to incorporate the radioisotopes into the radiation device is proposed and described with reference to a ^{35}S applicator. Carboxymethylcellulose as well as acetylcellulose were used for the preparation of the thin plaque in which the radioisotope ^{35}S was incorporated. By evaporating the solvent a thin foil was obtained which had the surface wt of 4 mg/cm^2 in the case of acetylcellulose. Its mechanical properties are very good. Since acetylcellulose is water insoluble, eluted activity during soaking was found to amount to 8.8% of the over-all activity; this value does not increase any more after 120 min of elution. Another applicator carrier was made of polymethylmethacrylate; for this purpose the proprietary resin preparation Superacryl, used in dentistry, was employed. The material allows one to prepare the carrier in any shape under simple lab conditions. The use of polymethylmethacrylate affords several advantages, especially from the viewpoint of dosimetry. The mean atomic number of polymethylmethacrylate is very close to the mean atomic number of tissue and thus changes in the radiation dose due to β-ray scatter from the carrier are compensated by scattered radiation from the tissue. On account of β-ray reflection from the carrier of the applicator, the radiation intensity of ^{35}S increases by 1.2% with a polymethylmethacrylate plaque possessing a surface wt of 140 mg/cm^2. Polymethylmethacrylate offers the further advantages of being compact and relatively unbreakable. Two types of applicators were prepared for practical use; for irradiation of the eye and for irradiation of an even surface of 1 to 2 cm^2. (BBB)

41288 PHYSICAL BASIS OF PROTON THERAPY. R. Wideroe (Universitat, Zurich). Radiazioni Alta Energia, 1: 151-69(July 1962). (In German)

Heavy particles such as protons, deuterons, or alpha particles are of great interest for biological and clinical applications. Protons with energies up to 150 Mev possessing a sufficient range in water can be produced by synchrocyclotrons of not too large dimensions and are the most advantageous for application in therapy. A series of experiments is described that indicates the macroscopic characteristics of the proton beam such as the depth dose curves and isodose curves. In therapy the fact becomes important that during exposure the energy of the protons has to undergo a small variation in order to get a depth-dose curve with a constant plateau just before the end of the range. The microscopic characteristics of protons of high (100 Mev) and low (10 Mev) energy were determined by means of Bethe's formula for the ionization on impact and compared with those of electron rays of 30 Mev energy. The values obtained give information on the biological action of the rays on cells both of high and of low oxygen content. Various measured results are included for purposes of comparison. (auth)

41289 DOSE DISTRIBUTION IN TELECOBALT MOVING THERAPY OF THE HYPOPHYSIS. H. Buttenberg (Röntgenund Radiuminstitut der Medizinischen Akademie, Erfurt, Ger.). Radiobiol. Radiotherap., 5: 407-13(1964). (In German)

The fundamental conditions in telegamma therapy of the head are discussed as to stationary-field and moving-beam irradiation. As a contribution to telegamma-arc therapy of the pituitary gland isodoses are established according to measurements of a paraffin-phantom of the skull. Under the conditions used of 180° arc angle, 55 cm arc radius, 2 × 2 and 4 × 4 cm field size with irradiation over the crown of the head as well as over the forehead different radiation doses of the surrounding cerebral tissue and of the lenses as well as involvement of the trunk were seen. Hence most favorable seems to be the supraorbital irradiation with 2 × 2 cm field size. (auth)

41290 RADIATION DOSE TO HUMAN ORGANS IN DEEP X-RAY THERAPY. V. S. Valkov and G. Slatarev (Geschwulstforschungsinstitut, Sofia). Radiobiol. Radiotherap., 5: 415-18(1964). (In German)

By radiation therapy of bronchial carcinoma and cancer of the breast the peripheral upper layers of the liver are exposed to a considerable direct radiation. In the most cases the radiation insult is overcome because of the small range of irradiated tissue and the great adaptability of the liver. The myocardium is assumed to be much less adaptive as in intensely irradiated patients in this region cardiac insufficiency is almost the rule. (auth)

41291 DOSIMETRIC PROBLEMS IN X-RAY THERAPY OF MALIGNANT TUMORS OF THE URINARY BLADDER. L. Lintner and J. Benes (Staff Hospital, Prague). Radiol. Austriaca, 13: 69-74(1962). (In German)

Methods for transcutaneous x irradiation of urinary bladder tumors that lie at a depth of 2 to 7, or 4 to 9 cm dorsal from the symphysis are compared. Two standardized methods, which vary only in the angle that the central axis of the radiation fields makes with the horizontal plane, are evaluated. Serious differences were not found clinically. When these techniques of x-radiotherapy were used to treat patients in an early study, 6 of 14 showed 5-yr survivals. In a later study 12 patients of 21 treated survived 5 yr. There were no skin reactions or changes in the blood picture. Cystitis was treated with antibiotics, and in 12% of 129 patients there was dysuria. In 4 cases necrotic changes of the bladder mucosa were observed, of which one required surgical intervention. No radiation fistulas were observed and there were no rectal reactions. The cystocopic controls occasionally showed localized pale areas with small phlebectases, but without evidence of hemorrhage. (TCO)

41292 METHODS FOR CALCULATING AND OBTAINING FAVORABLE DOSE DISTRIBUTIONS IN DEEP THERAPY WITH HIGH-ENERGY PROTONS. Bengt G. Karlsson (Uppsala Univ.). Strahlentherapie, 124: 481-92(Aug. 1964). (In German)

Several methods for calculating and obtaining favorable dose distributions for high energetic protons used in depth therapy are discussed. It is shown that a long dose plateau can be obtained in an irradiated object by means of a water absorber and a so-called ridge-filter. Using this method, a uniform dose can be obtained in the entire pelvic area during irradiation of genital carcinomas. (auth)

41293 MULTIPLE-FIELD IRRADIATION OF BLADDER TUMORS IN TELECOBALT THERAPY. Rudolf Birkner, Gerhard Dietz, Gerhard Hinz, and Dietlof Puppe (Rontgeninstitut und der Strahlentherapeutischen Abteilung im Stadt. Krankenhaus Moabit, Berlin). Strahlentherapie, 124: 493-512(Aug. 1964). (In German)

A new irradiation procedure, using a three-field-method, is reported. Tumors of the urinary bladder can be irradiated with high doses. Special consideration is given to a uniform dose distribution in the area of the total urinary bladder, of the tissue adjacent to the bladder, and of the most important lymphatical drainages, to an excellent protection of the rectum, and to an accurate and simple method for localization of the irradiation fields, which will also give a sufficient accuracy during routine measurements. Different possibilities for field combinations for different incident doses are discussed. The dose distribution as function of the patients contours was investigated. A pendulum arrangement was used for adjusting the oblique incident fields in order to get a good reproducibility. (auth)

41294 TELECOBALT THERAPY THROUGH PLASTER CASTS. Cuno Wieland and Helmut Kuttig (Universität, Heidelberg). Strahlentherapie, 124: 520-3(Aug. 1964). (In German)

Dose measurements of telecobalt therapy through plaster casts are reported. Since the secondary electrons arising from the cast have a considerable action on the surface dose, the build-up effect is nullified. The depth dose is not validly affected. (auth)

41295 CLINICAL ASPECTS OF IODINE METABOLISM. E. J. Wayne, Demetrios A. Koutras, and W. D. Alexander (Philadelphia, F. A. Davis Company, 1964). 314p. $9.00.

The metabolism of inorganic and organic iodine is discussed with emphasis on pathological aspects of iodine metabolism and the diagnosis of thyroid disease. Techniques are described for the measurement of thyroid uptake of a tracer dose of ^{132}I, measurement of plasma inorganic iodine and the absolute iodine uptake after a tracer dose of radioiodine, estimation of protein bound ^{131}I after administration of a tracer dose, and measurement of the uptake of ^{131}I-triiodothyronine by erythrocytes. Procedures are also described for the chemical microdetermination of iodine in biological samples. Data on iodine-containing drugs and goitrogens are appended. (900 references) (C.H.)

41296 PROCEEDINGS OF THE 1ST ANNUAL MEETING OF THE JAPANESE ASSOCIATION OF NUCLEAR MEDICINE, NOV. 23, 1961. Tokyo, The Japan Radioisotope Association, 1962. 65p.

English abstracts are presented for 82 papers presented at the first annual meeting of the Japanese Association of Nuclear Medicine, held in Tokyo, Nov. 1961. The papers indicate the present status of nuclear medicine in Japan and cover a wide range of diagnostic tracer tests and counting methods. (C.H.)

41297 PROCEEDINGS OF THE 2ND ANNUAL MEETING OF THE JAPANESE ASSOCIATION OF NUCLEAR MEDICINE, NOV. 25, 1962. VOL. 2. Tokyo, The Japan Radioisotope Association, 1963. 76p.

English abstracts are presented for 71 papers presented at the Second Annual Meeting of the Japanese Association of Nuclear Medicine, held in Tokyo, Nov. 1962. The papers indicate the present status of nuclear medicine in Japan. Emphasis is placed on the use of radioisotopes in diagnostic tests in the fields of hematology, endocrinology, gastroenterology, and cardiology. (C.H.)

41298 HET METEN VAN DE DOSIS BIJ RONTGENCINEMATOGRAFIE. (Measuring the Dose in X-Ray Cinematography). Gerard van Boheemen. Thesis, Leiden, Rijksuniversiteit, 1963. 113p.

A literature survey was made of the measurement of radiation dose in x-ray cinematography, particularly in the field of diagnostic radiology. The factors affecting the radiation dose are discussed with emphasis on the energy of the primary x-ray beam. Technical devices available for cineradiography are reviewed. The methods of measurement used are described, and the results are reported. The possibility of a direct relation between the beam energy and the known units of radiation was investigated. One hundred motion pictures made during roentgenography of the stomach, 10 other cinefilm investigations, and 12 heart catheterizations with angiographies are discussed. (J.S.R.)

41299 NEUTRONS IN RADIOTHERAPY: SLOW NEUTRONS, FAST NEUTRONS AND OTHER HEAVY PARTICLES. J. F. Fowler (Hammersmith Hospital, London). p.185-214 of "Biological Effects of Neutron and Proton Irradiations. Vol. II." Vienna, International Atomic Energy Agency, 1964.

Two distinct types of neutron therapy are evaluated: fast neutron therapy and capture therapy. Capture therapy with thermal neutrons appears a bad proposition, but the use of epithermal neutron beams makes it a possibility, especially if boron concentrations in humans can be increased. Pharmacological, radiobiological, and physical work in this direction is being carried out. Fast neutron therapy is a good proposition, if the depth doses (as well as they can be determined from the scanty present data) are weighted with the oxygen-enhancement gain factors for neutrons of various energies, taking into account the wide spread of uncertainty in these OER's. It appears that fast neutron beams with a modal energy exceeding 4 or 5 Mev will be required to treat deep tumors. The question of the possible effect of inelastic processes at higher neutron energies is entirely open, but if this contribution is neglected, an optimum neutron energy may be 7 to 10 Mev. (If inelastic processes give a higher oxygen gain factor, the optimum energy would be higher.) Further work on fast neutrons would be worthwhile. Negative π-mesons may be a good proposition, too. Fast-proton, deuteron, and alpha-particle beams, while admirable for the non-malignant cases for which they are used, do not appear to lead to advances in the treatment of cancer because their high LET is restricted to less than the final millimeter of particle track. (auth)

CHEMISTRY

General

Refer also to abstracts 41640 and 42162.

41300 (BNL-870) CHEMISTRY OF ISOTOPES. Jacob Bigeleisen (Brookhaven National Lab., Upton, N. Y.). Oct. 16, 1963. Contract AT-30-2-GEN-16. 16p.

Brookhaven Lecture Series No. 30.

A brief survey is presented of the principles of isotope chemistry and their application to the study of intermolecular forces and geochemistry, and of the biological effects of deuterium. (D.L.C.)

41301 (K-DP-356) ZONAL ULTRA CENTRIFUGE. Barbara S. Bishop (Oak Ridge Gaseous Diffusion Plant, Tenn.). [nd]. Contract W-7405-eng-26. 27p.

The described computer program is designed to calculate the sedimentation coefficients of particles of a given size and density, referenced to 20°C in water, as the particle migrates through the density gradient at a rate determined by the amount and duration of the applied acceleration on the zonal ultra centrifuge. A more complete documentation of the program may be found in ORNL-3502 and ORNL-3656. (auth)

41302 (NP-14281(p.219-37)) DYE-SENSITIZED PHOTOCONDUCTIVITY OF ZINC-OXIDE FILMS. L. I. Grossweiner and S. J. Dudkowski (Illinois Inst. of Tech., Chicago).

The kinetics and mechanism of sensitization of photoconductivity in zinc oxide thin films by the presence of eosin dye films was studied. An elementary model is used to interpret the results. (R.E.U.)

41303 (ORNL-TM-642) CHEMICAL TECHNOLOGY DIVISION, UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, JULY 1963. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Nov. 8, 1963. Contract W-7405-eng-26. 61p.

Foam was effectively condensed by passing it through an orifice at a velocity sufficient to cause at least 50% reduction of pressure. Orifice diameters of 0.015, 0.100, and 0.250 cm were equally efficient for foam composed of 0.05 to 0.08 cm dia bubbles. Small spherical thoria beads having high resistance to crushing and low internal porosity were prepared by dispersing a 4.5 $\underline{M}$ thoria sol through an orifice into a mixture of carbon tetrachloride and isopropyl alcohol producing gel beads which were calcined at 1000°C. The rate-controlling mechanisms for the sorption of uranium hexafluoride on sodium fluoride pellets are: transfer across the gas film, diffusion in the pore space, and diffusion through the UF_6–NaF complex. Experimental data were correlated on the basis of a model involving simultaneous diffusion and irreversible reaction. Two high level waste calcinations runs using simulated FTW-65 Purex waste containing four times the normal sodium content are reported. (auth)

41304 (ORNL-TM-775) CHEMICAL TECHNOLOGY DIVISION, UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, DECEMBER 1963. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 35p.

A large sample of salt from the excavation at the site of the planned Coach experiment was analyzed and the results of water leach tests and acid leach of the water insoluble are reported. Tests with fused salt showed about the same results as those with raw salt except the water insoluble was nearly all slime (–50 mesh). Spherical beads of thoria or thoria–urania can be prepared at a controlled particle size in the range from 50 to 1000 μ by the sol-gel process, discharging the sol through a nozzle into a medium of 2-ethylhexanol to dry and solidify the gel for subsequent firing. About 1000 g of microspheres were prepared for evaluation tests. (auth)

41305 (ORNL-TM-776) CHEMICAL TECHNOLOGY DIVISION, UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, AUGUST 1963. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). June 1964. Contract W-7405-eng-26. 51p.

Spherical refractory ThO_2 of 50- to 250-μ diameter was reproducibly prepared by firing spherical thoria gel made by dispersing and drying thoria sols in agitated CCl_4–isopropyl alcohol solutions containing sorbitan monooleate. A life operation test of four canned-rotor type pumps under consideration for installation in the Hanford Waste Calcination Prototype Facility was initiated. The effects of steady and pulsed flows on the pressure exerted at the bottom of pulsed columns containing sieve or nozzle plates were measured and show orifice coefficients which differ significantly from the usual value of 0.6. For the Transuranium program, europium scrub test using the standard tantalum sieve plate column resulted in HETS values of 17 inches at 50°C. (auth)

41306 (TID-4005(Pt.2b)) SUMMARIES OF THE USAEC BASIC RESEARCH PROGRAM IN CHEMISTRY (ON SITE). (Division of Research, AEC and Division of Technical Information Extension, AEC). Aug. 1964. 490p.

The objectives and current status of the individual research projects supported at the AEC laboratories and other Government-owned facilities are summarized. The summaries are arranged according to institution and division. Subject and author indexes are included. (D.L.C.)

41307 (UCRL-9787(Rev.)) BULK MIXING OF IMMISCIBLE LIQUIDS IN BAFFLED CYLINDRICAL TANKS. L. H. Weiss, J. L. Fick, R. H. Houston, and T. Vermeulen (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 8, 1962. Contract W-7405-eng-48. 35p. (CONF-8-8)

From American Institute of Chemical Engineers 50th National Meeting, Buffalo, May 1962.

Two factors account for incomplete bulk mixing of immiscible liquids: partial settling of droplets in the emulsion phase, and resistance to breakup by residual second phase. In the present experimentally based quantitative treatment, the first effect depends upon Froude, Reynolds, and Weber numbers; the second, upon Weber number alone. (auth)

41308 (ORNL-tr-259) DETERMINATION OF THE SPECIFIC SURFACE OF RADIOACTIVE CATALYSTS. A. A. Baladin, V. I. Spitsyn, N. P. Dobrosel'skaya, and I. E. Mikhailenko. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Izv. Akad. Nauk SSSR, Otd. Khim. Nauk, 379(1964). 4p.

A new variation of an adsorption vacuum apparatus which is used to determine the specific surface of radioactive solid bodies, using the BET method on a krypton base, was proposed. The surfaces of radioactive and nonradioactive magnesium-sodium sulfate catalysts for the dehydration of alcohols were determined; it was shown that when the ^{35}S isotope is introduced, the specific surface of the radioactive samples does not essentially differ from that of the nonradioactive samples of similar composition. When the sulfate catalyst is bombarded by fast electrons or nuclear reactor neutrons, the specific surface increases somewhat. (auth)

Analytical Procedures

Refer also to abstracts 41662 and 41728.

41309 (AERE-R-4645) A LOW-BACKGROUND LIQUID COUNTER AND ITS APPLICATION TO BIOASSAY DETERMINATIONS. P. J. Gomm and J. D. Eakins (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1964. 15p.

The development and performance of a low-background liquid counter for determining beta-emitting radionuclides in solution is described. The background of this counter containing distilled water is about 3 cpm with an efficiency of over 5% for beta emitters with E_{max} = 1.4 Mev. The background count rates of urine, blood, and solutions of fecal samples are discussed with particular reference to the potassium-40 content. The application of the counter to the routine determination of phosphorus-32 in urine is described, with methods for decontamination of the counter after use to maintain the low background. In the case of exposure to thulium-170, the activity in fecal samples measured by liquid counting is compared with that obtained by gamma spectrometric and end-window beta counting. (auth)

41310 (CEA-R-2509) METHODES D'ANALYSES CONTINUE ET SEMI-CONTINUE DE GAZ DISSOUS DANS L'EAU SURPRESSEE. (Methods for Continuous or Semi-Continuous Analysis of Gases Dissolved in Pressurized Water). Paul Vignet, Roger Gabilly, Jacques Lutz, and Roger Zermizoglou (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1964. 66p.

Hydrogen analyzer: The relative variation of the resistance of a palladium or platinum–palladium alloy wire immersed in water, is measured during the absorption of hydrogen. The calibration curves have been determined for a Pd wire at temperatures from 180 to 280°C. At low temperatures a palladium–platinum alloy has been used. The best conditions of operation for the analysis have been determined from the theoretical and experimental studies of the absorption of hydrogen dissolved in water by a metal. Oxygen analyzer: It is well known that the oxygen dissolved in water reacts with thallium metal to give thallium hydroxide. This compound is soluble and increases the electrical conductivity of the water. This increase in conductivity is directly proportional to the oxygen concentration. A differential conductivity meter has been developed for the measurement of dissolved oxygen. The range of this apparatus extends from 10^{-3} to 10^2 and more, ppm of O_2 dissolved in water. It enables the direct determination of O_2 dissolved in electrolytes without reducing their conductivity. The best conditions for a low chemical background noise have been determined and a relation for the calibration has been established. The rate of conversion of oxygen into thallium hydroxide is related to the dimensions of the thallium bed. Analysis of the total amount of gases dissolved in water: A sample of water at high temperature and pressure is isolated in a bomb placed in a by-pass of a pressurized loop. The water is outgassed by cooling and the pressure of the gases above the liquid phase is measured. This pressure is a function of the total amount of dissolved gases in water. By using an eudiometric method, the fraction of combustible gas can be measured. The calibration curves have been computed and checked experimentally. The time for a measurement is 30 minutes, the precision better than ±5 per cent and the sensitivity higher than 1 cm^3 H_2/kg of water. (auth)

41311 (CEA-R-2563) DOSAGE DU PLUTONIUM PAR DILUTION ISOTOPIQUE ETAT DES ETUDES AU 1.1.1964. (Plutonium Determination Using Isotopic Dilution. Status of Research, Jan. 1, 1964). Jean Chenouard and Monique Lucas (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucleaires, Saclay). Aug. 1964. 63p.

The uranium/plutonium ratio can be determined in a fuel after irradiation by isotopic dilution using a solution containing uranium-233 and plutonium enriched in the 240 or 242 isotopes. A description is given of the measurement method, the calibration, the solution preparation techniques, and the mass-spectrometric analysis. To use this method it is necessary, after mixing, for the isotopes to be distributed in the same way in the system both for the sample atoms and those of the tracer. This condition leads to difficulties which become apparent, particularly during calibration. The use of an electric computer has made it possible to reduce the time required for analysis and to simplify the checking of results. The U/Pu ratio can be determined to 3 or 4 per cent if a ^{240}Pu-rich tracer is used, and to better than 2 per cent using ^{242}Pu. ^{235}U consumption is measured by a particular technique involving a uranium hexafluoride analysis. The depletion is measured to $\pm 5 \times 10^4$. (auth)

41312 (CEA-R-2564) DOSAGE DU PLUTONIUM PAR DILUTION ISOTOPIQUE DANS LES COMBUSTIBLES IRRADIES. TRAITEMENT CHIMIQUE—MODE OPERATOIRE. (Determination of Plutonium in Irradiated Fuels by Isotopic Dilution. Chemical Treatment—Method of Preparation). Monique Lucas (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1964. 40p.

Plutonium determination in irradiated fuels has been carried out for several years by isotopic dilution in collaboration with SECACI and SSM. The difficulties arising during the application of this method have led to a review of all the steps in the process, in particular the chemical treatment of solutions of irradiated samples intended for isotopic analysis by mass spectrometry. This work has shown the importance of the valency cycle which should make it possible to obtain a uniform isotopic distribution in sample-tracer mixtures, and also a satisfactory U/Pu separation. Now it has been noticed that the presence of an excess of uranium considerably modifies the oxidation-reduction reaction kinetics of the plutonium. Therefore, certain parts of the operational technique were changed so as to have an efficient cycle and to thereby improve the U–Pu separation; the stability of the thermionic emission of the plutonium, connected to the quantity of residual uranium, has at the same time been improved and more precise isotopic analyses can now be carried out. An attempt was also made to eliminate as far as possible the isotopic contaminations by using a more rational operational method; the equipment used has been the object of a special study.

The evaporations are carried out so as to prevent the formation of saturated vapors inside the glove box. The material which cannot be changed after each operation is carefully cleaned every time a new sample is treated. With this technique, a second calibration of the traced T_2 has been undertaken using a new standard solution. This solution has been prepared very carefully by weighing uranium and plutonium of known chemical purity, and it is believed that it can be guaranteed to be a good reference solution. The value of the $^{233}U/^{242}Pu$ ratio of the tracer has been obtained with a relative accuracy of 0.5 per cent. This modified method is now being applied to the analysis of rods irradiated in G_3. (auth)

41313 (CEA-R-2595) COMPARISON ENTRE LES RESULTATS D'ANALYSE BRITANNIQUES ET FRANCAIS SUR LES LOTS D'OXYDE DE PLUTONIUM FOURNIS POUR RAPSODIE I. (Comparison of British and French Analytical Results Carried Out on Plutonium Oxide Batches Supplied for Rapsodie I). Jacques Corpel (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Aug. 1964. 29p.

The United Kingdom Atomic Energy Authority had to supply the CEA with 45 kilograms of plutonium in oxide form for the manufacture of Rapsodie I. The main analysis was the plutonium content of the product, which had to fit with several precise specifications: isotopic composition, $\beta\gamma$ total emission, loss on heating, surface area, and impurities content. The analytical verifications have been made by the analysts of the "Production Group" of Windscale, on one side, and by the analysts of the Plutonium Department of Fontenay-aux-Roses, on the other side. The concordance between the analytical results has been excellent, and it has not been necessary to appeal to arbitration of a third laboratory for the 39 batches which made the delivery. (auth)

41314 (CONF-692-1) A CONTINUOUS ISOTOPE DERIVATIVE PROCEDURE WITH DIRECT READOUT FOR AMINO ACIDS. W. J. Blaedel and M. A. Evenson (Wisconsin. Univ., Madison). [1964]. Contract AT(11-1)-1082. 22p. (SM-55/51)

From Symposium on Radiochemical Methods of Analysis, Saleburg, Austria, Oct. 1964.

It appears possible in principle to put the isotope derivative procedure for amino acids on a continuous automated basis, with direct readout. The well-known PIPSYL procedure is not suited for continuous analysis. However, it is possible to incorporate alanine into non-labile Co(III) complex on a continuous basis. The reaction is quantitative and rapid, and the labeled derivative is stable toward reduction and substitution for at least several hours, which is ample for the isotope derivative procedure. The quantitative composition of the complex still needs to be established, and the separation-purification step still needs to be worked out. (auth)

41315 (DP-823) AN IN-LINE INSTRUMENT FOR DETERMINING PLUTONIUM IN PROCESS STREAMS. T. Richard Herold (Du Pont de Nemours (E. I.) & Co. Savannah River Lab.). Mar. 1963. Contract AT(07-2)-1. 13p.

A prototype, in-line instrument was built which uses the $^9Be(\alpha,n)^{12}C$ reaction to measure plutonium concentrations of aqueous or organic process streams. The process stream flows through a capsule filled with beryllium oxide chips. Neutron counters in a polyethylene moderator monitor neutrons from the (α,n) reaction in the beryllium. ^{239}Pu concentrations as low as 0.04 gram/liter can be measured to within 10%. The maximum operating range is limited only by criticality considerations. (auth)

41316 (HW-51762) ANALYTICAL CONTROL QUALITY REPORT, APRIL–JUNE 1957. C. G. Hough (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1, 1957. Contract W-31-109-eng-52. 27p.

The HAPO Analytical Control Quality Program is reviewed. The proposed application of the statistical quality control techniques to the Redox process is considered. Finally, a complete summary of past and current analytical quality data is presented. (D.L.C.)

41317 (NYO-4700(Rev.)(Suppl.1)) HEALTH AND SAFETY LABORATORY MANUAL OF STANDARD PROCEDURES. (New York Operations Office. Health and Safety Lab., AEC). Aug. 1963. 312p.

Additions and corrections are given for NYO-4700(Rev.), a manual of analytical methods used by the Health and Safety Laboratory of USAEC. (D.L.C.)

41318 (PAN-522/VIII) SPEKTROGRAPHISCHE SPURENBESTIMMUNG SELTENER ERDEN MIT TRAGERDESTILLATIONSMETHODE. (Spectrographic Microdetermination of Rare Earths Using Carrier Distillation Methods). B. Strzyzewska, Z. Radwan, and J. Minczewski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1964. 18p.

A method for microdetermination of all the rare earth elements with the exception of promethium is described. The method consists of a carrier distillation of the rare earths out of graphite powder in d-c arcs. CsF was used as the carrier material. (tr-auth)

41319 (SC-TM-64-938) ANALYSIS OF LUTETIUM METAL BY SPARK SOURCE MASS SPECTROSCOPY. J. W. Guthrie (Sandia Lab., Albuquerque, N. Mex.). Aug. 1964. Contract AT(29-1)-789. 10p.

Results are reported of analyses of 26 bulk impurity elements in 5 different commercially obtained lutetium metal samples. A detection limit range of 0.5 to 10 ppm atomic was used. An outline of the analytical method is given. (auth)

41320 (TID-21139) THE DESIGN AND USE OF AN ADVANCED, INTEGRATED AUTOMATIC SYSTEM AND COMPUTER PROGRAM FOR NUCLEAR ACTIVATION ANALYSIS. (Texas. Agricultural and Mechanical Coll., College Station). [196?]. Contract AT(40-1)-2671. 20p. (SM-55/116)

Conditions are given under which instrumental gamma-ray spectrometric methods may be applied to radioactivation analysis. An automated system, the Mark II, and a computer program, the AA-6, for carrying out the application are described together with their operation. The costs of the automated system and computer program are considered. Some experimental results are given for the determination of Co and Cs in distilled water. (D.L.C.)

41321 (CEA-tr-R-1756) DOSAGE PHOTOMÉTRIQUE DIRECT DES ÉLÉMENTS DE TERRES RARES D'APRÈS LES TACHES CHROMATOGRAPHIQUES SUR PAPIER. (Direct Photometric Determination of Rare Earth Elements after Spot Chromatography on Paper). A. K. Babko, M. E. Vdovenko, and M. V. Kopa. Translated into French by B. de Trezvinsky from Zavodsk. Lab., 29: 645-9(1963). 10p.

A method for the determination of rare earths based on the direct measurement of the intensity of coloration of chromatographic spots on paper under reflected light is described. It permits the determination individually of the rare earths at a concentration of >10% in a mixture of 4 to 5 elements with a reproducibility of ±10%. The method for obtaining regularly shaped spots is given. (tr-auth)

41322 (JPRS-26310(p.22-6)) REDUCTION OF URANIUM FROM LOW-GRADE URANIUM ORE BY THE VOLUMETRIC ANALYSIS SYSTEM WITH ALUMINUM FOIL. Kuan-hua Li and Fu-chang Ting. Translated from K'o Hsueh T'ung Pao, No. 6, 533-4(June 1964).

An improved form of the "Fu-ehr-k'o-fu" phosphate method for the analysis of uranium ore samples is given. The method comprises reducing U(VI) in the solution to U(IV), coprecipitating U(IV) with thorium phosphate, dissolving the precipitate in sulfuric acid, and titrating the U with ammonium vanadate. The improvement consists in using Al foil in place of $Na_2S_2O_4$ to reduce U(VI) to U(IV). Some experimental results are given which compare the improved method with other methods. (D.L.C.)

41323 GRAVIMETRIC DETERMINATION OF Zr(IV) BY MEANS OF G ACID (KALIUM SALT). Gr. Popa, Gh. Baiulescu, and S. Moldoveanu (Univ. of Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Chim., 11: 415-17(1963). (In Rumanian)

A new reagent, β-naphtol-6.8-bisulphonic acid (kalium salt), is proposed for the gravimetric determination of Zr(IV). The reagent presents a high selectivity. (auth)

41324 DETERMINATION OF PEROXIDE BY AUTOMATIC COLORIMETRY. E. K. Dukes and M. L. Hyder (E. I. du Pont de Nemours & Co., Aiken, S. C.). Anal. Chem., 36: 1689(July 1964). (TID-20037)

An automatic colorimetric method was developed that is very suitable for the determination of the amount of H_2O_2 formed at very low doses in the radiolysis of aqueous solutions. The method is applicable to nearly neutral solutions, gives good precision over a range of 5 ppb to 8 ppb, and is sufficiently sensitive to determine the amount of peroxide formed by <10^4 Rad in many systems. The reaction adapted for the peroxide analysis consists of the oxidation of the leuco base of phenolphthalein by peroxide in the presence of Cu^{2+}. The resultant phenolphthalein color is measured at 534 mμ. (P.C.H.)

41325 THE ANALYSIS OF STAINLESS-STEEL NEUTRON-ACTIVATION PRODUCTS BY COMBINED GROUP SEPARATION AND γ-RAY SPECTROMETRY. J. W. McMillan (United Kingdom Atomic Energy Authority, Royal Arsenal, London). Analyst, 89: 594-8(Sept. 1964).

An ion exchange method is described for separating stainless-steel activation products into three groups before analysis by γ spectrometry. The method was devised for samples from pressurized water loops containing mixtures of radioactive nuclides difficult to analyze by direct γ spectrometry. (auth)

41326 THE DETERMINATION OF URANIUM-235 BY NEUTRON ACTIVATION AND RING-OVEN SEPARATION OF MOLYBDENUM-99–TECHNETIUM-99. D. A. Hilton and D. Reed (Central Electricity Generating Board, Gloucestershire Berks, Eng.). Analyst, 89: 599-602 (Sept. 1964).

A method is described for determining uranium-235 in a uranium sample by a neutron activation technique. The fission product, molybdenum-99–technetium-99, is separated from the neutron-activated sample on a ring-oven, and is then determined by γ spectrometry. The precision of the method is about 1% over the range 0.4 to 0.7% of uranium-235. (auth)

41327 NEUTRON ACTIVATION IN GEOCHEMISTRY: METHODS OF DETERMINATION OF Ta, Th, Co, AND Sc. J.-C. Schiltz and C. Coquema (CEN, Fontenay-aux-Roses, France). Bull. Soc. Franc. Mineral. Crist., 87: 156-62 (Apr.-June 1964). (In French)

A method for the determination of Ta, Th, Co, and Sc, using neutron activation and paper chromatography, is described. The method can be divided into three steps: the simultaneous irradiation of the sample and control, radiochemical separation and purification of the element desired by paper chromatography, and measurement of the induced radioactivity by γ spectrometry. The method is beginning to be used in routine analysis. (J.S.R.)

41328 GAS CHROMATOGRAPHIC SEPARATION AND ADSORPTION OF NOBLE GASES, OXYGEN AND NITROGEN ON MODIFIED ZEOLITES OF TYPE X. V. Bosacek (Inst. of Physical Chemistry, Prague). Collection Czech. Chem. Commun., 29: 1797-1802(Aug. 1964).

The effects of the cations Li^+, Na^+, and K^+ in the synthetic zeolite of type X on the adsorption characteristics of argon, oxygen, nitrogen, krypton, and xenon and on the gas-chromatographic separation of mixtures of these gases were investigated. The relationship between the slope of the adsorption isotherms and the sequence of the retention curves was demonstrated in gas-solid chromatography on the molecular sieves mentioned and the suitability of the potassium sieve for the separation of mixtures of Ar, N_2, Kr, and Xe and O_2, N_2, Kr, and Xe was proved. (auth)

41329 THE DISTRIBUTION OF RUBIDIUM, CESIUM AND BARIUM IN THE OCEANS. Ernst Bolter, Karl K. Turekian, and Donald F. Schultz (Yale Univ., New Haven). Geochim. Cosmochim. Acta, 28: 1459-66(Sept. 1964).

Rubidium, cesium, and barium were determined in several oceanic profiles by a neutron activation procedure based on the extraction of salt from 100 ml samples by freeze-drying. Assuming a constant strontium-chlorinity ratio of 0.0425, strontium was used as an internal flux monitor. For 19.0% chlorinity the average concentrations of these three elements are 125 μg Rb/l (10 samples), 0.30 μg Cs/l (28 samples), and 13 μg Ba/l (6 samples) with very little variation with depth or geographic location. Rubidium and cesium apparently are not efficiently transported to great depths by organisms, and cesium at least is not in exchange equilibrium with deep-sea clays. The barium data are for six stations only, mainly from areas of low productivity and low barium concentrations in associated deep-sea sediments. High oceanic barium values might be expected in areas of high productivity and associated high barium in deep-sea sediments. (auth)

41330 PROCESS CONTROL IN THE PRODUCTION OF Pu^{238} AND Np^{237}. E. K. Dukes and R. S. Dorsett (E. I. du Pont de Nemours & Co., Aiken, S. C.). Ind. Eng. Chem., Process Design Develop., 3: 333-6(Oct. 1964).

Laboratory facilities and analytical methods are described that were used to perform numerous analyses on highly radioactive samples from the ^{238}Pu–^{237}Np process. Major problems were containment of high levels of alpha activity, shielding of personnel from high levels of beta-gamma radiation, and the determination of one actinide of low concentration in the presence of a high concentration of another actinide. (auth)

41331 DETERMINATION OF SUB-MICROGRAM QUANTITIES OF COPPER IN BIOLOGICAL MATERIAL BY ACTIVATION ANALYSIS. K. G. Kjellin (Karolinska Sjukhuset, Stockholm). Intern. J. Appl. Radiation Isotopes, 15: 461-8(Aug. 1964).

A fast-sensitive and reliable method is described, the accuracy of which was especially tested in the 10^{-1} to 10^{-2} μg range. The neutron irradiation was carried out in flux of about 2×10^{12} n/cm^2 sec during 12 to 24 hr. After chemical separation of the samples (wet ashing, followed by separation on an anion exchange column) the induced ^{64}Cu activity was measured at the 0.51 Mev-peak and compared with a standard. The method was mostly used for copper determination in cerebrospinal fluid and central nervous system samples. The values found for different central nervous system tissues agree fairly well with recently reported spectrophotometric and spectrographic values. (auth)

41332 COMMENT ON "SPUTTERING ION SOURCE FOR SOLIDS." Harold P. Smith, Jr. (Univ. of California, Berkeley). J. Appl. Phys., 35: 3067(Oct. 1964).

It is shown that the sputtering ion device developed by Liebl and Herzog for mass analysis of solid surfaces probably cannot be used for quantitative analysis. (D.C.W.)

41333 SPECTROPHOTOMETRIC DETERMINATION OF URANIUM WITH AMMONIUM AURIN TRICARBOXYLATE. T. T. Lai and T. L. Chang (Cheng Kung Univ., Tainan, Taiwan, China). J. Chinese Chem. Soc. (Taiwan), 6: 106-17(Mar. 15, 1960).

In order to develop a sensitive and precise spectrophotometric method for uranium determination, the reaction of uranium(VI) with aluminon, the ammonium salt of aurintricarboxylic acid, was rigorously examined. Uranium reacted with aluminon to give a pink color absorption complex with the maximum absorbance at 535 mμ at an optimum pH of 4.0 to 4.8. The presence of two kinds of absorption complex, UO_2^{2+} – ATA and $(UO_2^{2+})_2$ – ATA, was proved, the electromigration tests for both were shown to be negative. The molar extinction coefficient of UO_2^{2+} – ATA was found to be 7400 and that of $(UO_2^{2+})_3$–ATA, 12000, with instability constants of 5.0×10^{-7} and 2.8×10^{-12}, respectively. The practical sensitivity was 0.5 to 1 ppm. The color reaction was also found to conform with Beer's law, and the intensity did not change within four weeks. (auth)

41334 DETERMINATION OF MICRO AMOUNTS OF LEAD BY THE "ISOTOPE DILUTION METHOD OF ANALYSIS" WITH ThB(Pb^{212}) AS A TRACER. Ying-mao Chen (National Taiwan Univ., China). J. Chinese Chem. Soc. (Taiwan), 6: 118-26(Mar. 15, 1960).

Determination of micro amounts of lead with ^{212}Pb as a tracer by the isotope dilution method was studied. ^{212}Pb can be easily obtained from thorium nitrate by extracting with dithizone. If dithizone in chloroform solution is saturated with lead containing ^{212}Pb and equilibrium is established with the aqueous layer containing varying amounts of lead, the amount of lead in the aqueous solution can be easily found by simply measuring the activities in the organic layer from the following relation: $A_s = A(M_i)/(M_i + M_s)$. With this relation, the determination of micro amounts of lead in aqueous solutions can be made without any auxiliary chemical methods. (auth)

41335 SPECTROPHOTOMETRIC DETERMINATION OF THE FORMATION CONSTANTS OF CERIUM AND THORIUM COMPLEXES OF ETHYLENEDIAMINETETRAACETIC ACID. Kuan Pan, Tong-ming Hseu, and Ching-hsien Wu (National Taiwan Univ., China). J. Chinese Chem. Soc. (Taiwan), 6: 12-25(Sept. 15, 1959).

A systematic ultraviolet spectrophotometric study of the versenate complexes of cerium(III) and thorium(IV) in acidic solutions of various ionic strengths was made. It was found that the cerium(III) versenate complex in aqueous solution exhibited a characteristic absorbancy maximum at 285 mμ, and that cerium(III) and versenate ion reacted in the ratio of 1 : 1 to form a complex. The reaction between thorium(IV) and versenate ion was studied using the cerium(III) versenate complex as an indicator. The results indicated that thorium and versenate ion reacted in the 1 : 1 ratio. The formation constants (log K_f) obtained at ionic strength of 0.1, 0.3, and 0.5 for the complexes were extrapolated graphically to infinite dilution to give the corresponding thermodynamic constants of 16.75 and 20.13 at 25°C, respectively. For the determination of very small quantities of thorium, the spectrophotometric titration of standard cerium(III) versenate complex solution and thorium nitrate solution was performed by using the absorption band of cerium(III) versenate complex as an indicator. (auth)

41336 DIRECT COMPLEXOMETRIC TITRATION OF ZIRCONIUM WITH VERSENE USING GALLEIN AS INDICATOR. Peng-joung Sun (National Taiwan Univ., China). J. Chinese Chem. Soc. (Taiwan), 7: 143-53(Dec. 15, 1960).

Gallein (pyrogallolphthalein) was previously introduced as a metal indicator in the complexometric titration with EDTA (ethylenediaminetetraacetic acid) and successfully applied to the titration of zirconium. A method for the direct titration of zirconium with versene (the disodium salt of EDTA) was proposed. A soluble complex of 1 : 1 zirconium-versene was formed during titration. Gallein indicator changed its color from orange red to a clear golden yellow at the end point. Stoichiometric results were brought about within the pH range 0.5 to 1.6. The sharpest color change was around pH 1.0. The titration was carried out in hydrochloric acid medium. The effect of the presence of various foreign ions in approximately equimolar proportions on the titration was observed. Forty-eight ions were tested. Among these only the following were found to interfere: antimony(III), cerium(IV), chromate, fluoride, iron(III), molybdenum(III), molybdate, oxalate, permanganate, phosphate, sulfate, tartrate, tin(II, IV), titanium(III), and vanadate. (auth)

41337 CHELATOMETRIC TITRATION OF LANTHANUM WITH GALLEIN INDICATOR. Peng-joung Sun (National Taiwan Univ., China). J. Chinese Chem. Soc. (Taiwan), 9: 41-6(Mar. 31, 1962).

A method using Gallein as indicator for the direct titration of lanthanum with the disodium salt of EDTA was proposed. With this indicator, lanthanum ion can be titrated at the pH of 5.5 to 6.5, using hexamethylenetetramine as buffer. At the end point, the violet color disappeared, giving rise to a red color. The interference of approximately equimolar concentration of various foreign ions was observed. Rare earth metal may be titrated along with lanthanum under the same conditions, as shown by the presence of cerium ion. (auth)

41338 METHOD FOR THE MEASUREMENT OF THE RADIOACTIVE CONTENT OF WASTE WATER. F. J. Haughey and R. M. Manganelli. J. Water Pollution Control Federation, 36: 88-95(1964).

The measurement of radioactivity in sewage is complicated by the presence of the solid fractions, and experiments were therefore carried out on the distribution of added iodine-131, phosphorus-32, and thallium-204 among the various solid fractions of domestic sewage. (UKAEA)

41339 NEW RADIOMETRIC METHOD FOR DETERMINING TRACES OF CHLORIDE IONS. Kálmán Burger. Magy. Kem. Folyoirat, 70: 143-7(Apr. 1964). (In Hungarian)

A radiometric method for determination of Cl^- ions was developed on the basis of the effect exerted by Cl^- ions on the solubility of AgCl in water. The Cl^- content of the solution may be calculated by the decrease in solubility due to the increase of the Cl$^-$ concentration. Measurements were carried out by means of a column containing AgCl labeled with ^{110}Ag; the activity of the mother solution was derived on the basis of the γ activity of the system, determined by means of a counter and a scintillation head. Freshly prepared radioactive AgCl with perchloric acid was used for the preparation of the microsolubility column. In view of the light sensitivity of AgCl, the apparatus was covered with a dark coating. The solubility product of AgCl and the stability constants of the AgCl complexes were determined in 1M HClO$_4$ solution, representing the first such measurement in a mineral acid solution. The results agreed well with the data reported by J. Bjerrum et al. (Stability Constants, The Chemical Society, London, 1958), thus indicating that the acidity of the solution affects only slightly the solubility constants of AgCl. (TTT)

41340 MEASUREMENTS OF SOFT β-RADIATION ISOTOPES IN A LIQUID SCINTILLATOR USING ONE-CHANNEL APPARATUS. [PART] II. Csányi Piroska Fodorné, Béla Lévay, and András Salamon. Magy. Kem. Folyoirat, 70: 184-9(Apr. 1964). (In Hungarian)

In a previous study, it was found that a single-channel liquid scintillation detector may be used for measuring relatively high-activity tritium-containing samples. This method was further improved to make it also applicable for determination of low-activity systems. The tritium samples were used in the form of ^{3}H$_2$O and hydrocarbon. The operations were carried out with the scintillator at +10°C, an amplification of 1000x, an operational voltage of 1600 v, and a resolution of 5 v. The optical filter used eliminated completely the phosphorescence of the solvent and reduced that of the glass cell by an order of magnitude; thus, the samples could be measured after 2 hours in the darkness. The tritiated water was dissolved in a toluene–ethanol mixture, terphenyl was used as the scintillator. The measuring efficiency decreased linearly with increasing water content as a result of the diluting effect of the ethanol and the decrease of scintillator concentration but the water did not exhibit any substantial quenching action. Within the range investigated, the measuring efficiency was found to be independent from the specific activity; the lowest detectable activity was 1.4×10^{-5} μcurie/ml. Tests with xylene containing tritium resulted in a measuring efficiency of 53 ± 5% without optical filters, with filters, 80% efficiency was reached. No such absolute efficiency could be established when the measurements were carried out with ^{3}H$_2$O because no standards are available. (TTT)

41341 2-(p-SULFOPHENYLAZO)-1,8-DIHYDROXY NAPHTHALENE-3, 6-DISULFONIC ACID AS A SENSITIVE REAGENT FOR RARE EARTH METALS. Kailash N. Munshi and Arun K. Dey (Univ. of Allahabad, India). Microchem. J., 8: 152-9(June 1964).

A spectrophotometric study of the color reaction of 2-(p-sulfophenylazo)-1,8-dihydroxy naphthalene-3,6-disulfonic acid (SPADNS) with rare earth metals for the determination of micro amounts of rare earths is described. The absorbance curves of the complexes at pH 6.0 show the λ_{max} for La anc Ce to be 545 mμ; for Pr, Nd, Tm 550 mμ; for Y 555 mμ; for Eu, Tb, Dy 560 mμ and for Sm, Ho, Er, Er, Yb it is 565 mμ. The λ_{max} of the reagent at this pH is 515 mμ. The study was made at 580 mμ where the reagent absorbs very little. The molar ratio for all the chelates was found to be 1 : 1 by the method of continuous variations as well as by mole ratio method. The optimum conditions for the microdetermination of rare earth metals using this reagent are described and include the effect of pH on the color intensity of the chelate, effect of excess of reagent on the absorbance of the chelate, range of adherence of Beer's law, sensitivity, molar extinction coefficient, rate of color formation, and stability of color at room temperature. (auth)

41342 CHROMOGENIC REACTIONS OF CERIUM(III) WITH AMMONIUM AURIN TRICARBOXYLATE AND ITS APPLICATION TO ANALYSIS OF CERIUM(III). Satendra P. Sangal (Univ. of Allahabad, India). Microchem. J., 8: 169-75(June 1964).

The formation of a reddish-violet colored chelate between cerium(III) and Aluminon (λ_{max}; 540 mμ) is reported. Absorbance measurements indicate the composition of the chelate to be 1 : 1 (Ce : Aluminon). Adherence to Beer's law is observed over 0.37–12.6 ppm of cerium. The chelate is stable between pH 4.5 and 8.5. The value of log K (K = stability constant) was calculated by three methods, which gave values of 4.1, 4.0, and 4.4. The sensitivity as defined by Sandell is 0.07 γ per square centimeter. Effects of various diverse ions were also studied. (auth)

41343 AN ION-EXCHANGE METHOD FOR THE ESTIMATION OF STRONTIUM-90 IN MILK. W. E. Blake, G. Oldham, and D. Sumpter (Loughborough Coll. of Tech., Leicestershire, Eng.). Nature, 203: 862-3(Aug. 22, 1964).

An ion exchange method for the determination of ^{90}Sr-^{90}Y in milk samples is described. The amounts of ^{90}Sr in seven milk samples were determined in duplicate and the results expressed as picocuries of ^{90}Sr/g Ca. When compared with the nitric acid method for ^{90}Sr analysis, the ion exchange method was found to be accurate, more rapid, and less haphazard, in addition to being easily adaptable to analyzing many samples concurrently. (H.M.G.)

41344 INVESTIGATION OF THE ELEMENT COMPOSITION OF SINGLE PARTICLES FROM FISSION PRODUCT CLOUDS. A. Sittkus and L. Lehmann (Max-Planck-Institut für Kernphysik, Heidelberg). Naturwissenschaften, 51: 352-5(1964). (In German)

A study to analyze quantitatively the hot particles suitable for the interference-free determination of the element composition using micro-samples is described. The particles were air filtered in December 1962. Contact autoradiographs were made of the particles and γ spectra were determined. Fe and Al contribute extensively to the structure; fission products make only a very small contribution to the mass of the particle. Reasons for the inhomogeneity of the particles are discussed. (J.S.R.)

41345 A NEW METHOD OF DETERMINATION OF CERTAIN GASEOUS FISSION PRODUCTS. A. Bouville, D. Blanc, J. Couly, and J. Fontan (Centre de Physique Nucléaire, Faculté des Sciences, Toulouse). Nucl. Instr. Methods, 27: 329-31(July 1964). (In French)

The method used previously to measure radon and thoron contents in air was applied to the dosimetry of gaseous fission fragments in a disintegration chain with solid radioactive elements. The apparatus and its application to selective detection of ^{88}Kr(T = 2.8 hr) from an irradiation channel of the reactor EL2 (Saclay) are described. This device can be suited to fission gases with shorter half lives. (auth)

41346 METHODS FOR THE DETERMINATION OF IODINE-131 IN FRESH MILK. Yoichiro Omono and Masamichi Saiki. Radioisotopes (Tokyo), 13: 304-7(July 1964).

An investigation was made to find an improved method to determine iodine-131 in fresh milk. In order to minimize iodine loss during ignition of milk, it was recommended that an NaOH solution be added to the milk in ratio of milk to the 1N NaOH solution as 1 : 19. A series of experiments indicated that inorganic iodine combines with fat and protein during experimental operation by Bergh's method. Since the iodine in fat-CCl_4 layer is not determined, Bergh's method was thought to be unreliable. To determine inorganic iodine, a composite system of ion-exchange and CCl_4 extraction is recommended. If the assumption, about 90% of iodine in milk exists as inorganic form, is accepted, total iodine-131 concentration could be easily calculated from the measurement of the above. (auth)

41347 DETERMINATION OF LOW CONCENTRATIONS OF CESIUM-137 BY COPRECIPITATION WITH AMMONIUM PHOSPHOTUNGSTATE. Cesar A. Nunes Viana (Centro de Estudos de Radioquimica (I.A.C.), Faculdade de Ciencias, Lisbon). Rev. Port. Quim. (Lisbon), 5: 153-4(1963). (In Portuguese)

A method for the determination of very low concentrations of ^{137}Cs, based on coprecipitation with ammonium phosphotungstate, is described. The phosphotungstate precipitate is dissolved in barium hydroxide solution, and the ammonium is removed with aqua regia. The ^{137}Cs is measured in the residue. Concentrations of the order of the MPC can be determined using this method. (J.S.R.)

41348 PAPER CHROMATOGRAPHY OF INORGANIC MATERIALS. Rf-VALUES FOR INORGANIC IONS IN METHANOL WASH LIQUID. Tiberiu Nascutiu (Inst. for Atomic Physics, Bucharest). Rev. Roumain Chim., 9: 273-82(Apr. 1964). (In German)

The R_f values for 67 inorganic ions were determined by the ascending method on chromatographic Whatman No. 1 paper with mixtures of methanol with HCl of 1, 2, 4, 6, 8, and $10\underline{N}$ (1:1) and methanol with HNO_3 of the same concentration in the ratio 2:1. The obtained R_f values are presented in tables arranged according to ion as well as R_f values. (tr-auth)

41349 PROCEDURE FOR DETERMINATION OF THE TOTAL β-ACTIVITY OF SOILS. V. L. Ananyan. Soobshch. Lab. Agrokhim., Akad. Nauk Arm. SSR, No. 4, 91-5(1961). (In Russian)

Measurements were made of the total beta activity of soils with an AS-2 counter. The amount of potassium in the soil was calculated from the number of pulses per minute from a given soil sample. Then from this value the equivalent beta activity of the soil was calculated. The potassium content determined by this method was compared with values obtained by chemical analysis. (M.C.G.)

41350 THE β RADIATION BACKSCATTERING ANALYSIS METHOD APPLIED TO THE SYSTEMS $PbO-Fe_2O_3$; $PbO-NiO$; $PbO-ZnO$; $Fe_2O_3-Al_2O_3$; AND Fe_2O_3-C. Gheorghe Marcu and Flaviu Buturca. Studia Univ. Babes-Bolyai, Ser. Chem., No. 2, 7-18(1963). (In Rumanian)

The β backscattering analytical method can be used to determine the composition of $PbO-Fe_2O_3$, $PbO-NiO$, and $PbO-ZnO$ with great precision with an error between 0.1 and 0.2%. $Fe_2O_3-Al_2O_3$ can be analyzed with an error between 5 and 10% and Fe_2O_3-C with an error of 2 to 5%. The method can be applied to the determination of the Pb in ZnO and to the analysis of the ashes obtained during roasting of pyrites. After the standardization curves are established for these systems, the analysis only takes 1 to 2 min. (tr-auth)

41351 ON THE DETERMINATION OF URANIUM AND THORIUM IN SEDIMENTARY ROCK OF CARBON. Heinrich Siemes and Ewald Schwarz (Technische Hochschule, Aachen). Z. Erzbergbau Metallhuettenw., 17: 233-8(May 1964). (In German)

An analytical method suitable for routine investigations for the determination of uranium and thorium in the sediments of the upper carboniferous was investigated. The study of x-ray fluorescence analysis for this purpose is reported. It was shown that this method is unsuitable because of the height of the detection range. Gamma spectroscopy could be used to detect U and Th concentrations of 1 ppm. The techniques used and the measurement results are described. (tr-auth)

41352 DETERMINATION OF LOW SPECIFIC ^{45}Ca ACTIVITIES BY LIQUID SCINTILLATION COUNTS. H. Vemmer and J. O. Guette (Universität, Gottingen, Ger.). Z. Tierphysiol., Tierernaehr. Futtermittelk., 18: 346-52 (1963). (In German)

A method for counting low specific activities of ^{45}Ca by liquid scintillation counting is described. Ca from animal tissues and excreta is transferred to $CaCO_3$, this is dissolved in $1.3\underline{N}$ HCl. Four ml of the solution, containing 100 mg Ca, are mixed with 17 ml of a liquid scintillator. Counting efficiency was 71%. Disturbing quenching effects were excluded. (auth)

41353 PREPARATION OF URANIUM HYDRIDE IN A QUARTZ TUBE FOR SPECTRAL STUDIES. I. I. Georgeskii. Zh. Prikl. Khim., 37: 1826-7(Aug. 1964). (In Russian)

Preparation of uranium hydride at hydrogen pressure of 10 to 40 mm Hg is described. The obtained UH_3 was identified to hydride previously prepared at 126 atm. (R.V.J.)

41354 ELECTROANALYTICAL CHEMISTRY OF THE RARE EARTHS. Edward Joseph Cokal. Thesis, Tucson, Ariz., Univ. of Arizona, 1963. 196p.

Acetonitrile was used as the solvent in polarographic and coulometric studies of neodymium, europium, samarium, and ytterbium. This study resulted in the development of successful procedures for the determination of europium and samarium and the analysis of mixtures. It also provided information useful in the elucidation of the mechanism of the co-reduction phenomenon observed in methanol solutions. The co-reduction does not occur in acetonitrile. The polarography of di- and tripositive europium in aqueous potassium chloride and in other aqueous supporting electrolytes was studied to obtain information pertaining to the mechanism of the reactions. It was found that the reduction of europium is dependent upon the anion concentration in such a manner as to suggest that complex formation plays a significant role in the mechanism. The reduction wave is polarographically reversible below a salt concentration of $0.10\underline{M}$ and irreversible above that value. The half wave potential is dependent upon the europium concentration and the temperature, but is independent of pH over a wide range. The polarographic evidence indicates that the currently accepted value for the standard potential of the europium(III) - (II) couple is seriously in error; a value of $E^\circ = -.380$ volt vs. N.H.E. is suggested. The apparatus and techniques developed for the coulometric determination of the rare earths in acetonitrile were found to be well suited to the determination of sodium at the micromole level. (Dissertation Abstr., 25: No. 1, 1964)

41355 SOME ASPECTS OF CERATE OXIDIMETRY. Surjit Singh. Thesis, St. Louis, St. Louis Univ., 1963. 122p.

The use of sulfatoceric acid as a volumetric reagent was furthered by seeking new applications. A procedure for the standardization against sodium oxalate was accomplished by adding about six grams of manganese sulfate as a catalyst to each oxalate sample before commencing the titration with sulfatoceric acid in $2\underline{N}$ sulfuric acid. The oxidation of oxalate is believed to take place through an intermediate Mn(III) oxalatocomplex. Various aspects of Andrews' iodine monochloride method were critically examined. The first part of the study comprised the titrimetric determination of thiocyanates with sulfatoceric acid. An explicit and more accurate experimental procedure was recommended. Determinations of cobalt(II), mercury(II), and zinc(II) were carried out by precipitating them as complex thiocyanatomercurates and titrating them with sulfatoceric acid. Titanium(III) and molybdenum(III) were also determined with sulfatoceric acid. The reduced metal ions obtained from a Jones reductor were directly collected in iodine monochloride solutions to avoid possible oxidation by air. The ability of iodine monochloride to undergo a 2-electron transfer was utilized in the final phase of this study. Hydrazines were found to be quantitatively oxidized to nitrogen and water. Determinations of hydrazine, phenylhydrazine, 2, 4-dinitrophenylhydrazine, methylhydrazine, dimethylhydrazine and semicarbazide were accomplished by using iodine monochloride as a preoxidant and catalyst followed by titration with sulfatoceric acid. Indirect determinations of selenous acid and manganese dioxide were carried out. The reagents were treated with an excess of standard hydrazine solution. The excess was back-titrated with sulfatoceric acid using the iodine monochloride method. The use of cobalt sulfate as a catalyst to promote the quantitative reduction of manganese dioxide and eliminate the formation hydrazoic acid was proposed. (A.G.W.)

41356 LOW TEMPERATURE ADSORPTION AND GAMMA SCINTILLATION SPECTROMETRY FOR MEASURING ARGON-41. Herbert Anderson Bevis. Thesis, Gainesville, Fla., Univ. of Florida, 1963. 127p.

In the proposed technique argon-41 is collected on charcoal by adsorption at −295.8°C and measured by radiological procedures using gamma scintillation spectrometry. Basic research on several parameters affecting low temperature adsorption was conducted. The optimum materials and operating procedures were combined to form the proposed sampling technique. The optimized system uses standard 6-14 mesh cocoanut shell charcoal as the adsorbent, a sample collection rate of 0.25 cubic feet per minute, and a sample volume of 1 cubic foot. The sample is collected and analyzed in a toroidal shaped copper adsorber cartridge and flat-bottom Dewar flask. The cartridge and flask were especially designed for use with liquid nitrogen and to provide a good geometry for radiological analysis. A field test of the proposed technqiue conducted at the University of Florida Training Reactor was quite successful. The sampling device functioned well and the radiological analysis of the sample was made without difficulty. The sensitivity of the system is estimated to be about 10^{-9} μc of argon-41 per cubic centimeter of air with an accuracy of ±15 per cent. (A.G.W.)

41357 I. DETERMINATION OF RADIOACTIVE NIOBIUM IN WATER AND FOODS. II. DETERMINATION OF RADIOACTIVE RUTHENIUM IN WATER AND SEWAGE. III. THE USE OF THIOMALIC ACID AS AN ANALYTICAL REAGENT FOR CADMIUM. Richard Francis Skonieczny. Thesis, Detroit, Wayne State Univ., 1958. 83p.

Glendenin's procedure for determination of radioactive niobium was studied. It was found that niobium can be precipitated as the hydrated oxide, Nb_2O_5, in sufficient amount from large volumes of solution, and with this method niobium activity was easily precipitated from four-liter samples of both tap water and hard water. Digestion with a mixture of concentrated nitric and sulfuric acids proved to be best for animal tissue. For plant tissues, dry ash methods proved to be most suitable. For the determination of ruthenium a method was developed whereby the ruthenium was oxidized to its maximum state with potassium permanganate and then reduced with hydroxylamine hydrochloride. Upon reduction with hydroxylamine hydrochloride, the ruthenium precipitated out, was collected, and redissolved in a small volume of acid. The conventional still for radioelements was then usable. The procedure was applicable also to sewage effluent samples. Analysis of samples of a cadmium precipitate with thiomalic acid revealed it to be the result of the reaction of one mole of cadmium per mole of the acid. Further experiments showed that the cadmium was quantitatively precipitated at a pH of approximately 3.5. A homogeneous precipitation procedure using glacial acetic acid and urea was developed. The precipitate was coarse, dense, and easy to filter. Quantitative recovery of cadmium was obtained. (A.G.W.)

41358 IONENAUSTAUSCHER. EIGENSCHAFTEN UND ANWENDUNGEN. (Ion Exchangers. Properties and Applications). Konrad Dorfner. Berlin, Walter de Gruyter & Co., 1963. 174p.

The use of ion exchangers is so extensive that both the student and the expert, after a brief review on the practical applications of ion exchangers, are left with many unanswered questions. An attempt was made to answer the most common questions and to compile the data available on the properties and uses of ion exchangers. The types of ion exchangers and their properties are reviewed. Their use as an auxiliary in the preparation of reagents, in pharmacy and medicine, in analytical chemistry, and in industry is then discussed in some detail. (J.S.R.)

41359 THIN-LAYER CHROMATOGRAPHY SCRAPER (Engineering Materials). (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). (CAPE-1122)

Drawings (2) are presented of a scraping device for rapid and quantitative transfer of extremely small zones of adsorbent from narrow glass plates into counting vials. Fifty samples (2-mm zones) can be collected in about 5 min. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

41360 RADIOCHEMICAL AND GAMMA SPECTROMETRIC ANALYSIS OF FALLOUT, 1961/1962. U. Nay and A. Kaul (Max-Planck-Institut für Biophysik, Frankfurt am Main). 15p. (CONF-337-24). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

In 1961 and 1962 radiochemical and γ spectrometric analyses were made of radioactive particles collected by rubbing the surface of airplanes flown at 1000 m, incinerated air filters, and water samples evaporated to dryness. The radiochemical separation procedures are described, and the γ spectra and half life measurements are reported. ^{59}Fe, ^{124}Sb, ^{125}Sb, and ^{54}Mn were detected for the first time in 1962. Isotopes from the fissioning of ^{234}U and ^{239}Pu were detected in 1961. (J.S.R.)

41361 RADIOCHEMICAL DETERMINATION OF POLONIUM, RADIUM, AND URANIUM IN THE POLLUTANT DUSTS OF AIR OF URANIUM MINES. H. Francois, et al. 15p. (CONF-337-27). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The analysis of mine dusts for the determination of Po, U, and Ra was investigated. Of the solvents tested, fuming nitric acid with the addition of Br gave the best results in the dissolution of the dusts. The solution was then centrifuged and the Po in the supernatant was deposited on Ag plates and determined by α counting. Ra was determined in the solution by the emanometric method. The determination of U by chromatography and fluorimetry in 2.5 $\underline{N}$ HNO_3 gave reproducible results. The laboratory procedure for the determinations is given. (J.S.R.)

41362 METHOD FOR MEASURING THE CONTENT OF FISSILE MATERIAL IN SUBSTANCES BY MEANS OF THERMAL NEUTRONS, PARTICULARLY FOR THE CONTROL OF THE BURNUP OF NUCLEAR FUEL ELEMENTS. (to Brown, Boveri and Cie. AG and Beteiligungs-und Patentverwaltungsgesellschaft m.b.H.). French Patent 1,297,636. May 21, 1962. Priority date Sept. 2, 1960, Germany.

The degree of burnup of a fuel element was determined by irradiating the fuel element with thermal neutrons, preferably produced by an Sb–Be source, and measuring the fast neutron flux emitted by the fuel element. This flux is about proportional to the fissile content. A schematic measuring apparatus consists of a shielded Be block, with a bore in each of two opposite sides. One of the bores is provided with a Pb lining, while ^{232}Th fission chambers are placed within the shield facing the lined bore. To inspect a fuel element it is inserted in the lined bore while a quantity of ^{124}Sb is inserted in the other bore. (NPO)

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Refer also to abstract 42295.

41363 (BLG-252) NOTES ON THE PHYSICAL CHEMISTRY OF ION EXCHANGE. L. Baetsle (Centre d'Étude l'Énergie Nucléaire, Brussels). Nov. 1963. 133p.

The main principles of chemical thermodynamics, with special emphasis on those concepts which are of interest to ion exchange reactions, are reviewed. The elements of the physical chemistry of electrolytic solutions are discussed, including the theories of Debye-Hückel and Guggenheim. The physical chemistry of sorption reactions is subsequently treated and the adsorption as well as ion exchange reactions are viewed from the general point of view of heterogeneous chemical equilibria in two phase systems. Important quantitative approaches to ion exchange equilibria in substances with a rigid matrix and in gel type ion exchangers are presented; the formal thermodynamic treatments are particularly emphasized since they constitute the connection between the thermodynamic parameters and the equilibrium data. The fundamentals of ion exchange kinetics are discussed, and the calculation methods of the performances of ion exchange columns are extensively treated. Finally, ion exchange equilibria involving trace components is treated briefly. (auth)

41364 (CEA-R-2350) CONTRIBUTION À L'ÉTUDE DE L'HYDROLYSE DES CARBURES D'URANIUM. (Contribution to the Study of the Hydrolysis of Uranium Carbides). Jean Spitz (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1964. 54p.

Thesis submitted to Université, Grenoble.

The hydrolysis of uranium monocarbide in neutral or acid medium leads to the formation of a complex mixture of hydrogen and hydrocarbons mostly saturated. When UC–U alloys are dissolved in hydrochloric-phosphoric medium, the free uranium contents can be determined with good accuracy from the composition of the gaseous phase. The hydrolysis of mixtures of uranium mono- and dicarbide in neutral or acid medium, leads to the formation of a complex mixture of hydrogen and gaseous and condensed hydrocarbons, the composition of which is principally dependent upon the UC_2 content. The reaction mechanisms which are presented for the hydrolysis of UC and UC_2 account for all experimental observations. (auth)

41365 (EURAEC-1111(Pt.2)) A STUDY OF SOME METAL OXIDATION PROBLEMS AND APPLICATION OF IMPEDANCE MEASUREMENT METHODS TO THE STUDY OF RESISTANCE TO CORROSION IN AN AQUEOUS MEDIUM. Quarterly Report No. 9, April 1–June 30, 1964. (Brussels. Université). Work Performed under United States–Euratom Joint Research and Development Program. Contract 012-63-10-TEEB. 35p.

The electrolytic measurement cell was optimized. The recording series of capacity-time curves was completed by means of various polarizations of the jumps in potential (platinum electrode). The coulometric equipment was adjusted and calibrated. (auth)

41366 (EURAEC-1129) A STUDY OF SOME METAL OXIDATION PROBLEMS AND APPLICATION OF IMPEDANCE MEASUREMENT METHODS TO THE STUDY OF RESISTANCE TO CORROSION IN AN AQUEOUS MEDIUM. Final Report No. 1. (Brussels. Université). 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 081-62-5-RDB. 22p.

Factors which can alter the shape and structure of the oxide formed by controlled oxidation of metals and alloys are studied. It is concluded that the introduction of certain mechanical or chemical defects modifies the means of access to the growth centers to a greater extent than their number or structure. Cadmium and copper–nickel alloys are used in this study. The development of equipment for studying the oxidation and halogenation of metals is discussed. (N.W.R.)

41367 (GA-3398) THE HIGH-TEMPERATURE CHEMISTRY OF FISSION-PRODUCT ELEMENTS. Summary Report, August 1, 1961–July 31, 1962. U. Merten and W. E. Bell (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Aug. 23, 1962. Contract AT(04-3)-164. 41p.

Studies of the high-temperature chemistry of the chlorides of Ru, Rh, and Pd were completed during the year. For each of these metal-chlorine systems, condensed phases and vapor species were identified, dissociation and vapor pressures were measured, and thermodynamic data were calculated from the pressure data. Studies of the Os–Cl system are almost complete. A summary of results is included, along with summaries for the Ir–Cl, and Ru–O systems. (J.R.D.)

41368 (GA-4449) MASS-SPECTROMETRIC STUDY OF THE RUTHENIUM–OXYGEN SYSTEM. J. H. Norman, H. G. Staley, and W. E. Bell (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Aug. 16, 1963. Contract AT(04-3)-164. 7p.

Knudsen-cell experiments in a mass spectrometer were carried out at 1150 to 1525°K and oxygen pressures of 2×10^{-5} to 5×10^{-4} atm. The results show that the predominant gaseous species is RuO_3 formed by the reactions $Ru(s) + \frac{3}{2} O_2 \rightarrow RuO_3(g)$ and $RuO_2(s) + \frac{1}{2} O_2 \rightarrow RuO_3(g)$. Heats of reaction at 1250°K for the above reactions were calculated to be -17 and $+54$ kcal/mole, respectively. (D.L.C.)

41369 (IS-876) MFOUR—CRYSTALLOGRAPHIC FOURIER SUMMATION PROGRAM. Mads Ledet (Ames

Lab., Ames, Iowa). May 1964. Contract W-7405-eng-82. 50p.

This program was written as a substitute for MIFR1. There are four notable differences: (1) no symmetry manipulations are performed; (2) no sorting is made with regard to sine-cosine codes; (3) summation is done completely in each direction before proceeding; (4) program is for the IBM 7074 (20K). (auth)

41370 (IS-917) EQUILIBRIA AND KINETICS OF THE REACTION OF PHOSGENE WITH THORIUM OXIDE. D. T. Peterson and D. J. Sundquist (Ames Lab., Ames, Iowa). July 1964. Contract W-7405-eng-82. 28p.

The reaction of phosgene with thorium oxide has been shown to be a good method for preparing thorium tetrachloride. The equilibria of the reaction showed that nearly complete utilization of phosgene could be attained in a properly designed reactor. The kinetics of the reaction could not be represented by a simple rate law but the effects of bed depth, particle size, mode of oxide preparation and temperature on the rate of reaction were established. The depth of the bed of thorium oxide and the particle size of the oxide did not affect the initial rate of reaction. At high conversions the rate of the reaction was probably controlled by the slow solid state diffusion of oxygen to the surface of the thorium tetrachloride crystals and the highest conversion of thorium oxide to thorium tetrachloride obtained was approximately 91%. The size of the crystallites in the thorium oxide particles increased as the temperature at which thorium oxalate was calcined to thorium oxide was increased. The resulting decrease in surface area decreased the initial rate of reaction. The temperature coefficient of the reaction rate was small and a temperature increase of approximately 200°C was required to double the rate of reaction. (auth)

41371 (LA-DC-6032) THE 1962 He^3 SCALE OF TEMPERATURES. II. DERIVATION. S. G. Sydoriak, T. R. Roberts, and R. H. Sherman (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 30p.

An Experimental Thermodynamic Equation (ETE) temperature scale valid from 0.2 to 2.0°K has been calculated for ^3He. The scale is based on new comparisons, (P_3, P_4), of ^3He and ^4He vapor pressures above 0.9°K; on the 1958 ^4He temperature scale; and on the best available data for several thermodynamic properties of ^3He from 0.2 to 2.0°K. The T_{62} Full-range Working Equation (FWE) scale, $\ln P_3 = -2.49174/T + 4.80386 - 0.286001\ T + 0.198608\ T^2 - 0.0502237\ T^3 + 0.00505486\ T^4 + 2.24846 \ln T$ fits the ETE scale and the (P_3, T_{58}) data and is therefore valid for use from 0.2 to the critical point, 3.324°K. The maximum deviation from the ETE scale is 0.4 mdeg and the standard deviation from the input data is 0.25 mdeg. The fit to the seven recalculated isotherms of Keller in the range of the 1962 ^3He scale can be determined by converting Keller's P_4's to equivalent P_3's, using direct P_4 to P_3 interpolation equations. The fit of the 1962 ^3He scale is as good as the fit of the 1958 ^4He scale to the same isotherms, the average displacements of the two scales both being 1.5 mdeg below the isotherms. The average standard deviation for ($T_{62} - T_{iso}$) and for ($T_{58} - T_{iso}$) is 1.2 and 1.0 mdeg, respectively, for these seven isotherms. (auth)

41372 (ORNL-P-281) REMOVAL OF URANIUM HEXAFLUORIDE FROM GAS STREAMS BY SODIUM FLUORIDE PELLETS. Leonard E. McNeese and Stanley H. Jury (Oak Ridge National Lab., Tenn.). [nd]. Contract [W-7405-eng-26]. 17p. (CONF-571-10)

From American Chemical Society 148th National Meeting, Chicago, Aug.-Sept. 1964.

The removal of uranium hexafluoride from a gas stream containing uranium hexafluoride and nitrogen by a single layer of sodium fluoride pellets was investigated. Experimental data on the rate and extent of sorption were obtained in the temperature range 29 to 225°C and uranium hexafluoride concentration range 0.57 to 10.9 mole per cent uranium hexafluoride. The results of this study indicate that the rate-controlling mechanisms are: transfer of uranium hexafluoride across a stagnant gas film surrounding the pellet, diffusion of gaseous uranium hexafluoride in the pores of the pellet, and diffusion of uranium hexafluoride through a layer of uranium hexafluoride—sodium fluoride covering the unreacted sodium fluoride in the interior of the pellet. The crystalline density of the complex, $UF_6 \cdot 2NaF$, was determined to be 4.13 g/cm^3 which indicates that incomplete reaction of the sodium fluoride will occur for pellets in which the initial volume void fraction is less than 0.807. A useful model was devised to represent the sorption of uranium hexafluoride by a single pellet of sodium fluoride. The experimental data were correlated on the basis of the model with a root-mean-square error of 12.0% for all points. (auth)

41373 (TID-20951) BASIC RESEARCH IN INORGANIC AND PHYSICAL CHEMISTRY AT HIGH TEMPERATURES. Sixth Annual Report. J. A. Cahill and A. V. Grosse (Temple Univ., Philadelphia. Research Inst.). June 30, 1964. Contract AT(30-1)-2082. 56p.

An oscillating crucible viscosimeter is described in which the viscosities of Hg and organic liquids were determined at room temperature, and the viscosity of Sn was determined at 925°K. The viscosity of liquid Tl was also determined and may be expressed as a function of temperature via: $\eta_{cp.} = 0.2942\ e^{2500/RT}$ or $\log_{10} \eta_{cp.} = -0.53134 + 552.5 \times T^{-1}$. The experimental activation energy of viscosity, H_η = 2500 cal/g at., is comparable to the value of 2270 cal/g at. predicted from theoretical estimates. Additional measurements on the surface tension of liquid U were made to 1850°K. The relationship between surface tension, σ, and temperature, T, is as follows: σ_U dynes/cm. = 1747 − 0.14 T °K. Results of surface tension measurements of UF_4 and ThF_4 can be described tentatively by the equations UF_4 σ dynes/cm. = $447 - 19.2 \times 10^{-2}$ T °K. ThF_4 σ dynes/cm. = $418 - 13.3 \times 10^{-2}$ T °K. The density of liquid Be was determined from its melting point to 2100°K. Its temperature dependence may be expressed as follows: D g/cc. = $1.871 - 11.62 \times 10^{-5}$ T °K. An expansion of melting, $\Delta V/V_s$ ~7%, was calculated from the liquid density at the melting point, and a solid melting point density calculated from recent high temperature x ray data. Melting Sb at high pressures produces a fusion curve which indicates that Sb contracts, $\Delta V/V_s = -0.45\%$, on melting. This contrasts with the volume changes based on extension of solid density data to the melting point and calculation of an expansion on melting equal to $\Delta V/V_s = +0.8\%$. The reaction of liquid Mn with BN was studied to 1700°K. A few cc of liquid Mn were contained in a BN crucible, and no wetting or interaction with the crucible was observed. Analysis of the melt showed less than 0.8% N. In a similar experiment 3 cc of liquid Al were contained in a BN crucible for 4 hr at 1600°K. Less than 0.01% N was detected in the Al, and a very clean looking ingot was produced. The reaction between ZrO_2 and W at 2900°K was checked in experiments preceding liquid density measurements on ZrO_2. X-ray-diffraction patterns of the ZrO_2 that was adjacent to the W crucible wall produced lines of pure cubic ZrO_2 only. Analysis of the melt showed less than 0.1 wt % W, if any. An alloy,

$B_{5.4}Al$, was contained on liquid Al_2O_3. The addition of B to an Al_2O_3 liquid crucible caused the following reactions to occur: $Al_2O_3 + 2\ B \rightarrow 2\ Al + B_2O_3$ and $5.4\ B + Al \rightarrow B_{5.4}Al$. Formation of a ThO_2 liquid crucible was achieved. This is a significant accomplishment because ThO_2 is the highest melting and highest boiling refractory oxide known. This latter consideration makes it possible, in principle, to contain liquids on ThO_2 at temperatures up to its boiling point, i.e., 4670°K. Experimental data and known relationships were used together with ones recently developed to establish the viscosity of liquid Hg from its melting point, 234.3°K, to its critical point, 1733°K. (auth)

41374 (UCRL-7167(Rev.I)) THE VAPOR PRESSURES OF 30 INORGANIC LIQUIDS BETWEEN ONE ATMOSPHERE AND THE CRITICAL POINT. David G. Edwards (California. Univ., Livermore. Lawrence Radiation Lab.). June 17, 1964. Contract W-7405-eng-48. 149p.

Literature values of the vapor pressures of H_2, HD, D_2, N_2, O_2, Ne, Ar, Kr, Xe, CO, NO, CH_4, SiF_4, N_2O, CO_2, HCl, HBr, HI, SF_6, H_2S, Cl_2, Br_2, NH_3, C_2N_2, SO_2, SO_3, HF, HCN, N_2O_4, CCl_4, and $SnCl_4$ have been compared with the Kirchhoff formula $\log P_K = -A/T + B$ between the normal boiling point and the critical point, where A and B are determined for each liquid. Plots are presented of the deviations computed by the equation $d = P_K - P_{obs}$. Based on accurately determined curves for 17 of these substances, empirical hypotheses were developed to allow the prediction of the most probable course of the deviation curve in cases where the data appeared to be unreliable. In addition, where precise data were available, the possibility of the existence of fine-structure curvature has been demonstrated. The deviation curves have been used to obtain tables of interpolated vapor-pressure values which are, in most cases, more accurate by one order of magnitude than any now in the literature, particularly where smoothed regression curves do not discriminate between random experimental errors and systematic deviations of an arbitrarily chosen formula from the real vapor-pressure curve. Since the deviation curve is invariably shown to approach the zero ordinate at the critical point with a large negative slope, the correspondence between the critical pressure and temperature is fixed with a high degree of confidence. A particular result of this work is that the critical pressure of NH_3 was shown to be about one atmosphere higher than the presently accepted value. The values for the critical points of CH_4, C_2N_2, HCN, and Br_2 have also resolved differences existing between various authorities in the literature. (auth)

41375 (UCRL-9987(Rev.)) AN EXPERIMENTAL TEST OF THE STEFAN-MAXWELL EQUATIONS. R. W. Getzinger and C. R. Wilke (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). Sept. 1963. Contract W-7405-eng-48. 24p.

The Stefan diffusion tube was utilized to determine the rate of mass transfer in three ternary systems in which two gases were simultaneously diffusing into a third stagnant gas. Constant evaporating binary liquid mixtures were used. The experimentally determined values are compared with the quantities predicted by an exact solution of the Stefan-Maxwell equations. Results of these and related comparisons indicate that: (a) unless the interacting influence of the two diffusing gases upon each other is considered, any predictive method will be seriously in error; and (b) the validity of the Stefan-Maxwell equations was established under experimental conditions involving significant interaction among simultaneously diffusing components. (auth)

41376 (UCRL-13123) PREPARATION OF $^{11}B_2O_3$ FROM $K^{11}BF_4$. Final Report. J. A. Neff and A. B. Amster (Stanford Research Inst., Menlo Park, Calif.). Aug. 21, 1964. For Univ. of California, Lawrence Radiation Lab., Livermore. Contract AT(04-3)-115. 5p.

A method was developed for preparing pure boric oxide, $^{11}B_2O_3$, from potassium fluoroborate, $K^{11}BF_4$. A 9.2-g sample of anhydrous $^{11}B_2O_3$ for neutron scattering studies was prepared from 40 g of $K^{11}BF_4$. Details of the preparation were first established using isotopically normal KBF_4 to minimize losses of the valuable ^{11}B isotope. The anhydrous $^{11}B_2O_3$ glass was ground and sized so that the entire sample passed through a 60-mesh screen and most of it was retained by a 12-mesh screen. The over-all yield for the preparation to unground glass was 83%. (auth)

41377 (UJV-940/63) FÁZOVÉ ZMĚNY PŘI REAKCI KYSLIČNIKU O SLOŽENI MEZI UO_3 AŽ $UO_{2.67}$ S VODNÍ PAROU. (Phase Changes in the Reaction of an Oxide of Composition between UO_3 and $UO_{2.67}$ with Water Vapor). Z. Urbanec and L. Sedláková (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1963]. 18p.

Described are the phase changes in the reaction of these oxides prepared by the thermal decomposition of $\alpha-UO_2(OH)_2$ or amorphous UO_3 in air saturated with water vapor at a temperature of 45°C. Both phases existing in the starting oxide, i.e., amorphous UO_3 and the phase $UO_{2.9}$, are changed into the dihydrate $UO_3 \cdot 2H_2O$ with a velocity dependent on the degree of dispersion of the oxide. The kinetics are described. The structure of the U_3O_8 included in the samples calcined at higher temperature is obviously hydrated very slowly, in which case there is a gradual oxidation of the uranium. Curves are given showing the infrared absorption of samples prepared by different techniques and also their diffraction patterns are given. Curves showing the gain in weight versus the time of exposure to water vapor are shown. Velocity constants for the rate of hydration at different O/U ratios are tabulated. (TTT)

41378 (Y-1470-1) X-RAY FLUORESCENCE TABLES: BARIUM STEARATE CRYSTAL. W. P. Amsbury, W. W. Lee, J. H. Rowan, and G. E. Walden (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). Aug. 17, 1964. Contract W-7405-eng-26. 198p.

A critical compilation of standard reference tables of x-ray fluorescence lines for a barium stearate crystal of nominal spacing is published in convenient form for experimental use. (auth)

41379 (KFK-tr-158) AUSFALLUNG VON URAN AUS EINER CHLORIDESCHMELZE MITTELS ZINK. (Precipitation of Uranium from a Chloride Melt Using Zinc). I. F. Nickov, C. P. Raspopin, and A. F. Carenko. Translated into German by Peter Buriks (Kernforschungszentrum, Karlsruhe, Germany), from At. Energ. (USSR), 15: 336-7 (1963). 8p.

A study was made to see if UCl_4, in an alkali chloride melt, reacts with zinc to precipitate uranium. After introduction of metallic zinc in the U^{4+}-containing chloride melt the formation of an insoluble precipitate was observed and the concentration of uranium in the salt mixture reduced practically to zero. Data are presented in tables and graphs. (M.C.G.)

41380 ACCURATE INTENSITY MEASUREMENTS IN SINGLE-CRYSTAL ANALYSIS BY NEUTRON DIFFRACTION. G. Caglioti (Comitato Nazionale per l'Energia Nucleare, C.C.R. Euratom, Ispra, Italy). Acta Cryst., 17: 1202-13(Oct. 10, 1964).

Two aspects of the problem concerning accuracy of intensity measurements in single-crystal analysis by neutron diffraction are discussed: the manner in which the experimental value of the intensity of a Bragg reflexion may be affected by the use of the ω- and 2θ-scan techniques; and the manner of controlling, where possible, the effect of simultaneous Bragg reflexions on the intensity. In addition, conceivable experiments of elastic neutron diffraction by means of a triple-axis spectrometer are discussed in connection with an accurate determination of the Debye–Waller factor. (auth)

41381 X-RAY INVESTIGATION OF AEROSOLS FROM WIRES EXPLODED IN NITROGEN. Frank G. Karioris (Marquette Univ., Milwaukee) and Jerome J. Woyci. Advan. X-Ray Anal., 7: 240-51(1964).

Wires of 18 different metals were exploded in nitrogen by the discharge of a 20-μF capacitor bank charged to 10 kv. The resulting aerosols were collected under nitrogen on membrane filters, which were mounted on glass slides and used directly in the sample holder of a recording x-ray diffractometer. The x-ray data were analyzed to determine the composition and approximate crystallite size of the particulates produced by the wire explosions in nitrogen and subsequent exposure to air. Nitrides were found as reaction products from the explosion in nitrogen of aluminum, iron, indium, tantalum, thorium, uranium, tungsten, and zirconium. No nitrides were detected in the samples from cadmium, copper, magnesium, molybdenum, lead, and tin explosions, although such nitrides are known to exist; and the aerosols produced in nitrogen by the explosion of silver, gold, molybdenum, platinum, and tin consist almost entirely of metal particles. Oxides are attributed to contamination of the nitrogen or exposure of the samples to air. Most of the crystallites observed were less than 1000 Å as determined from x-ray line broadening and confirmed in some instances by electron microscopy. For the UN_2 and ThO_2, crystallite sizes of the order of 130 and 50 Å, respectively, were observed. In samples comprised of a mixture of phases, the constituents usually have different mean crystallite sizes. The crystallite size is not affected dramatically by the ambient nitrogen pressure or voltage used. (auth)

41382 A THERMOGRAVIMETRIC STUDY OF THE MANDELATES OF ZIRCONIUM AND HAFNIUM. R. W. Adams and H. Holness (Univ. of Manchester, Eng.). Analyst, 89: 603-7(Sept. 1964).

The thermal decomposition of zirconium mandelate and hafnium mandelate was studied by using a Stanton recording thermobalance, with the object of assessing the use of these compounds for determining the two elements in admixture. It was concluded that their use cannot be recommended since the weight of the mandelate is greater than the stoichiometric requirement. (auth)

41383 SOME PECULIARITIES IN URANIUM OXIDATION BY TRIVALENT IRON IONS. Vikt. I. Snytsyn, G. M. Nesmeyanova, and A. I. Vikulov. At. Energ. (USSR), 17: 119-23(Aug. 1964). (In Russian)

Results are presented on the oxidation of UO_2 by Fe(III) ions in neutral sulfur- and chlorine–oxide solutions. One of the possible mechanisms by which the oxidation may occur is considered, and a series of factors affecting the oxidation reaction is determined. Results are given on the determination of the effect of SO_4^{-2} and HSO_4^- ions on the oxidation of UO_2 in chlorate solutions by Fe(III) ions. It is assumed that in the conditions studied oxidation of U occurs in the diffusion region. (tr-auth)

41384 REACTIONS OF $A_2^{III}B_3^{VI}$. SAMARIUM AND GALLIUM SELENIDES. G. Kh. Efendiev, Z. Sh. Karaev, and I. O. Nasibov. Azerb. Khim. Zh., No. 1, 125-31(1964). (In Russian)

Thermal, x-ray, and microhardness analyses showed that Sm_2Se_3 and Ga_2Se_3 with 1:1 molar ratios form a hexagonal $SmGaSe_3$ compound with a = 10.30 Å and c = 6.25 Å. In a vacuum the compound is stable up to its melting point. The compound is not soluble in organic solvents or H_2SO_4. In hot H_2SO_4 it dissolves slowly. It is easily dissolved in HCl and HNO_3 but dissolves poorly in alkali solutions. (R.V.J.)

41385 REACTIONS OF $A_2^{III}B_3^{VI}$. PRASEODYMIUM AND GALLIUM SELENIDES. I. O. Nasibov and Z. Sh. Karaev. Azerb. Khim. Zh., No. 5, 105-11(1963). (In Russian)

Thermal and x-ray analyses of praseodymium and gallium selenides revealed two compositions $PrGaSe_3$ and $PrGaSe_{7.5}$ with molecular ratios of $Pr_2Se:GaSe_3$ = 1:1 and 1:4, respectively. At elevated temperatures the compounds behaved as semiconductors with melting points at 1200 and 1225°C. The compounds were not soluble in benzene, toluene, or methyl, ethyl, or propyl alcohol. (R.V.J.)

41386 SOLUBILITY OF ZIRCONIUM PHENYLARSONATE. V. A. Malinovskii. Azerb. Khim. Zh., No. 5, 113-16(1963). (In Russian)

Zirconium phenylarsonate solubility was analyzed, and the analytical procedure is described. (R.V.J.)

41387 ELECTRIC CONDUCTIVITY OF URANIUM OXIDES AT HIGH TEMPERATURE: RELATION TO OXYGEN EQUILIBRIUM PARTIAL PRESSURE AND CHEMICAL COMPOSITION. APPLICATION TO STUDY OF THE $U_3O_8 \rightleftharpoons UO_2$ EQUILIBRIUM. A. Duquesnoy and F. Marion (Faculte des Sciences, Lille, France). Bull. Soc. Chim. France, No. 6, 1177(June 1964). (In French)

The isothermal variation curves of the electric resistance of UO_{2+x} $(0 < x < 0.25)$ and U_3O_8 were traced between 1200 and 800°C as a function of the oxygen equilibrium partial pressure. The partial pressures could be measured between 1 and 10^{-12} atm. The oxide UO_{2+x} is a semiconductor of the p type and U_3O_8 a semiconductor of the n type. The electric conductivity of UO_{2+x} is a simple function of the excess x of oxygen. Between 1000 and 1200°C the isothermal electric conductivity of UO_{2+x} is given by the relation $C_{UO_{2+x}} = C_{UO_2} + KX$. The isothermal curves of the variation of the electric conductivity of these oxides as a function of the equilibrium oxygen pressure make possible the study of the equilibrium $U_3O_8 \rightleftharpoons UO_{2+x}$. The equilibrium oxygen pressures are given by the relation $\log p_{O_2} = 24{,}300/T + 12.25$. (J.S.R.)

41388 STUDY OF THE REDUCTION OF URANYL SULFATE BY HYDROGEN OR HYDROGEN SULFIDE GAS: PREPARATION OF URANIUM OXYSULFIDE AT LOW TEMPERATURE. Jean-Marie Leroy and Gabriel Tridot (Faculte des Sciences, Lille). Bull. Soc. Chim. France, No. 6, 1178(June 1964). (In French)

The reduction of anhydrous uranyl sulfate by hydrogen or hydrogen sulfide was studied. The reduction to uranium dioxide was complete at 580°C in the hydrogen reduction. A mixture of H_2 and H_2S produced the dioxide at 300°C. The hydrogen did not enter the reaction, but improved the thermal conductivity and thus reduced the convection currents. The dioxide was used to prepare UOS at low temperature. The preparation was conducted at constant temperature with periodic weighings as a function of the duration of the H_2S passage. The product obtained is very pure and well crystallized. (J.S.R.)

41389 INCORPORATION OF URANYL CATIONS IN CARBONATES DURING FORMATION. R. Wey and I. Lauffenburger (Ecole Superieure de Chimie, Mulhouse, France). Bull. Soc. Chim. France, No. 6, 1182(June 1964). (In French)

Carbonates of Ca and Fe^{2+} were prepared in the presence of uranyl ions UO_2^{2+}. The analysis of the products obtained showed that the calcium carbonates underwent a structural modification. The formation of calcite took place in the presence of higher concentration of UO_2^{2+} than a mixture of calcite and vaterite. Only in the absence of the uranyl ion was it possible to prepare aragonite. The lattice of siderite was not modified. It appeared that the fixation of the UO_2^{2+} was made both by surface adsorption and by penetration to the interior of the crystalline lattice. It was possible to extract the UO_2^{2+} from the products thus formed by a solution of Na_2CO_3. (J.S.R.)

41390 THERMOGRAVIMETRIC STUDY OF THE DECOMPOSITION OF URANYL BROMIDE MONOHYDRATE. M. M. Gueguin (Faculte des Sciences, Rennes, France). Bull. Soc. Chim. France, No. 6, 1184(June 1964). (In French)

The thermal decomposition of $UO_2Br_2 \cdot H_2O$ under gaseous currents of nitrogen, oxygen + bromine, nitrogen + bromine, and oxygen was studied. Mixtures of UO_2Br_2 + UO_3 were obtained at 220°C under O_2, and amorphous UO_3 at 350°C. The other gases gave UO_2Br_2 at 220°C. Uranyl bromide, in N_2 or N_2 + Br_2, was not stable near 320°C, and UO_2Br was produced. This decomposed into UO_2 near 400°C under N_2 and near 480°C in a mixture of N_2 + Br_2. (J.S.R.)

41391 REACTIONS OF POSITIVE IONS WITH ARGON, NITROGEN, AND HYDROGEN. Jean-Charles Abbe and Jean-Pierre Adloff (Centre de Recherches Nucleaires, Strasbourg). Bull. Soc. Chim. France, No. 6, 1212-16 (June 1964). (In French)

A two-stage mass spectrometer was used to study reactions between positive ions with energies of 0.5 to 2 kev and argon, hydrogen, and nitrogen. The cross sections for charge transfer reactions were measured as a function of the nature and energy of the primary ions. (tr-auth)

41392 A MODEL FOR THE HYDROGEN BOND AND PROTON TRANSFER REACTIONS. R. F. W. Bader (McMaster Univ., Hamilton, Ont.). Can. J. Chem., 42: 1822-34(Aug. 1964).

A simple extension of Platt's model for determining the force constants in diatomic hydrides was used to investigate the properties of transition states for proton transfer reactions. The model was first tested by comparing the predicted and observed changes in bond lengths and stretching and bending frequencies for O—H ... O systems. The quantities predicted for the transition state are the geometry and the perpendicular bending frequencies. The implications of the results with regard to the interpretation of hydrogen—deuterium kinetic isotope effects are discussed. In particular, the variations in both the isotope effect and the geometry of the transition state with changing acid or base strength are considered in detail. (auth)

41393 MOLTEN ZIRCONIUM REACTS WITH N_2 IN AIR. Chem. Eng. News, 42: No. 37, 45-6(Sept. 14, 1964).

The reaction of molten zirconium with N_2 in air or Ar—O mixtures by the flash-heating technique is discussed. Gaseous ZrO is intermediate in the combustion process, and zirconium nitride, dioxide, and oxynitride are produced. The flash-heating technique involves the preparation and ignition of metal droplets with the intense thermal emission of a light pulse from a capacitor discharge lamp. (P.C.H.)

41394 PREPARATION OF Pu^{238} METAL. F. D. Lonadier and J. S. Griffo (Monsanto Research Corp., Miamisburg, Ohio). Ind. Eng. Chem., Process Design Develop., 3: 336-9(Oct. 1964).

Plutonium-238 oxalate, precipitated from a nitrate solution, was converted to plutonium tetrafluoride, which was reduced with calcium to plutonium-238 metal. Because of the high neutron flux of the plutonium tetrafluoride, many of the handling operations were made behind a 16-inch-thick Lucite barrier using remotely controlled manipulators. The process boxes were filled with greater than 96% argon having a dew point of −50°C to prevent spontaneous oxidation of the plutonium-238. The purity of the metal was determined by chemical analysis to be 99.13%, which compares favorably with the purity of plutonium-239 prepared by a similar procedure. The plutonium-238 was stored in water-cooled cans because of its high specific activity. (auth)

41395 THE CRYSTAL STRUCTURE OF SODIUM PERXENATE OCTAHYDRATE. James A. Ibers, Walter C. Hamilton, and D. R. MacKenzie (Brookhaven National Lab., Upton, N. Y.). Inorg. Chem., 3: 1412-16(Oct. 1964). (BNL-8059)

Sodium perxenate octahydrate, $Na_4XeO_6 \cdot 8H_2O$, is orthorhombic with cell constants a = 11.86, b = 10.36, c = 10.43 Å, space group Pbcn, Z = 4. A three-dimensional x-ray diffraction investigation resulted in a complete structure determination. The perxenate ion is approximately a regular octahedron with a mean Xe—O distance of 1.864 ± 0.012 Å. The greatest deviation of an O—Xe—O angle from the ideal 90° is 2.6 ± 0.8°. The two crystallographically independent sodium atoms are surrounded by very distorted octahedra composed of water molecules and perxenate oxygen atoms. A complex array of hydrogen bonds completes the structure. (auth)

41396 THE CRYSTAL STRUCTURE OF SODIUM PERXENATE HEXAHYDRATE. Allan Zalkin, J. D. Forrester, and David H. Templeton (Univ. of California, Berkeley). Inorg. Chem., 3: 1417-21(Oct. 1964). (UCRL-11478)

Crystals of $Na_4XeO_6 \cdot 6H_2O$ were studied by x-ray diffraction, and the subsequent crystal structure analysis determined its composition. This material crystallizes in the orthorhombic space group Pbca, with a = 18.44, b = 10.103, and c = 5.873 Å. There are four molecules per unit cell and the calculated x-ray density is 2.59 g/cc. The structure consists of two types of layers stacked alternately in the a direction and tied to each other by hydrogen bonds. One type layer contains a hexagonal array of all of the perxenate and half of the sodium ions, and the second type has all of the water in octahedra about the remaining sodium ions. The perxenate ion in this salt is octahedral with an average Xe—O bond distance of 1.84 ± 0.02 Å. (auth)

41397 THERMODYNAMICS OF BINARY ALLOYS. I. THE LITHIUM—BISMUTH SYSTEM. Melvin S. Foster, Scott E. Wood, and Carl E. Crouthamel (Argonne National Lab., Ill.). Inorg. Chem., 3: 1428-31(Oct. 1964).

Electromotive force measurements were made on cells of the type Li|LiCl— LiF|Li in Bi (X_{Li}= atom fraction Li) for compositions of the alloy from pure Bi to Bi saturated with $Li_3Bi(s)$ and for temperatures between 775 and 1100°K. The electrolyte consisted of 70 mole % LiCl and 30 mole % LiF. A secondary reference electrode, which consisted of Bi saturated with $Li_3Bi(s)$ was used in most of the cells in place of the Li anode. Its potential was independently measured against the Li electrode. From the measurements, a least-squares derived equation relating the excess chemical potential (cal/mole) of Li in the alloy as a function of temperature and composition for the region studied was found to be $\Delta\mu^{E}_{Li} = [9397 + 18.16T - 0.0109T^2] + [7103 - 19.44T + 0.0068T^2]X_{Li}$. The standard free energy of formation of $Li_3Bi(s)$ was derived as a function of temperature. (auth)

41398 HYDROGEN TRACER STUDIES ON THE REACTIONS OF URANIUM HYDRIDE WITH AQUEOUS OXIDIZING AGENTS. John B. Hunt and Henry Taube (Univ. of Chicago). Inorg. Chem., 3: 1431-7(Oct. 1964).

The reaction of UD_2 with concentrated HCl in H_2O forms HD as the principal gaseous product. When the concentration of the acid is reduced to ca 9.5 M, reaction is much slower, and H_2 and D_2 are the chief gaseous products. Little D is lost to the solvent by exchange, although D loss does become a feature of the results at still lower acidity. The rates of the reaction are very sensitive to the anion that is present. When a metal ion such as Ce(IV) is the oxidizing agent, the D_2 originally contained in the solid is liberated essentially quantitatively and no other gaseous product is formed. These and related results are interpreted on the assumption that a barrier layer, presumably UO_2, governs the rate and mechanism of the reaction. (auth)

41399 CHEMICAL CRYSTALLOGRAPHY OF RARE EARTH FLUORIDES. L. R. Batsanova (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, No. 3, Ser. Khim. Nauk, No. 1, 83-90(1963). (In Russian)

Composition, infrared spectra, and x-ray analysis of rare earth fluorides were studied at various temperatures. The crystallo-chemical properties of rare earth trifluorides prepared at 600°C were compared with the properties of products prepared at higher temperatures. It is shown that temperature affects the optical properties of rare earth fluorides, inducing or amplifying optical anisotropy and altering absorption band intensity on the infrared region. (R.V.J.)

41400 SURFACE CONTAMINATION OF La_2O_3 AND Nd_2O_3 BY B_2O_3: A SOURCE OF ERROR IN X-RAY DIFFRACTOMETRY. Stephan Stecura and William J. Campbell (Bureau of Mines, College Park, Md.). J. Am. Ceram. Soc., 47: 468(Sept. 21, 1964).

During an investigation of the high temperature crystalline modifications of La_2O_3 and Nd_2O_3, some anomalous x-ray data were observed that were found to be a result of surface contamination of the samples. When samples of the A-type (hexagonal) La_2O_3 or Nd_2O_3 were heated in an x-ray diffractometer furnace at temperatures ranging from 1000 to 1300°C several changes in the x-ray diffraction patterns were observed. Initially, all diffraction lines were those of the A-modification. As the intensity of the A-phase decreased, lines of a second phase (denoted α) appeared; the α lines increased in intensity with increasing time and temperature. After prolonged heating, the α phase became the major component, and a few lines of an additional new phase (denoted β) appeared. By spectrographic analysis, the most significant impurity noted was boron. By a process of elimination the winding core was found to be the source of boron contamination in the diffractometer furnace. (P.C.H.)

41401 FIRST TOWNSEND IONIZATION COEFFICIENT MEASUREMENTS IN DEUTERIUM. G. D. Rork and Lorne M. Chanin (Honeywell Research Center, Hopkins, Minn.). J. Appl. Phys., 35: 2801-2(Oct. 1964).

The electron ionization coefficient α/p_0 (cm × torr)$^{-1}$ was measured over an E/p_0 (volts/cm × torr) range from 20 to 100 in deuterium subjected to various purification procedures. The results obtained lie slightly below those previously reported by Rose; however, the agreement is within the combined experimental error. Comparison is also made with the measurements of the ionization frequency ν_i/p (sec × torr)$^{-1}$ of Cottingham and Buchsbaum. The present results, at a given E/p_0 value, lie above their data. The discrepancy between the a-c and d-c results is discussed. (auth)

41402 MECHANISM OF THE VAPOR LUBRICATION OF GRAPHITE. Peter Cannon (General Electric Research Lab., Schenectady, N. Y.). J. Appl. Phys., 35: 2928-9 (Oct. 1964).

The minimum pressure vs molecular size at which the vapor lubrication of graphite is effective (Savage's operating curve) can be transformed to a linear law. The law must demand the nucleation of a liquid-like adsorbed film, and this is reconciled with recent studies of physical adsorption on graphite. A physical model, consistent with the law, is outlined. (auth)

41403 PRESSURE DEPENDENCE OF THE ^{59}Co NUCLEAR MAGNETIC RESONANCE IN HEXAGONAL COBALT. David H. Anderson and George A. Samara (Sandia Lab., Albuquerque, N. Mex.). J. Appl. Phys., 35: 3043-4 (Oct. 1964).

The pressure dependence of the NMR frequency of ^{59}Co in fcc and hcp cobalt was measured, and the hyperfine constant was determined to be independent of temperature. (D.C.W.)

41404 SELF-DIFFUSION OF IONS INTO ION-EXCHANGE RESINS. J. Span (Univ. of Ljublijana, Yugoslavia) and M. Ribaric. J. Chem. Phys., 41: 2347-50 (Oct. 15, 1964).

A theoretical model for the self-diffusion of ions into an ion exchange resin is proposed, using the concept of an effective diffusion boundary layer with nonlinear concentration profile. The derived equation is of a general character and fit for wide concentration of the flowing solution. From it specialized equations already known for self-diffusion of ions in ion exchangers can be derived. To test the adequacy of the proposed model, series of experiments were performed on the self-diffusion of cesium ions into polystyrene sulfonic acid resin Dowex 50 × 8 from solutions of cesium and potassium chloride. The concentration of solutions was varied over a rather wide range. Several runs were made with different rates of the flow of the solution. Good fitting of experimental results with theoretically calculated curves over the whole experimental range indicates that the proposed model is adequate. (auth)

41405 RADIO-FREQUENCY AND MICROWAVE SPECTRA OF LiBr BY THE MOLECULAR-BEAM ELECTRIC-RESONANCE METHOD. A. J. Hebert, F. W. Breivogel, Jr., and K. Street, Jr. (Univ. of California, Berkeley). J. Chem. Phys., 41: 2368-76(Oct. 15, 1964). (UCRL-11012)

The molecular-beam electric-resonance technique was used to obtain dipole moments μ_v, quadrupole interaction constants of bromine $(eqQ)_v$, spin-rotation interaction constants c_{Br}, and rotational constants for $^6Li^{79}Br$ and $^6Li^{81}Br$ in several of the lower vibrational levels. Values were obtained from the observation of J = 1 radio-frequency spectra for three or more vibrational states and for $J = 1 \rightarrow J = 0$ microwave transitions. (P.C.H.)

41406 INFLUENCE OF COMPETITIVE DECOMPOSITION PROCESSES ON IONIZATION EFFICIENCY CURVES FROM ELECTRON IMPACT. Chava Lifshitz and F. A.

Long (Cornell Univ., Ithaca, N. Y.). J. Chem. Phys., 41: 2468-71(Oct. 15, 1964).

The energy dependence of ionization efficiency by electron impact for polyatomic molecules is influenced by the entrance of decomposition processes. The observed yield of parent ion drops sharply at the energy onset of a high-yield decomposition process. Ionization efficiency curves for products from other decomposition processes are similarly effected. These effects are particularly apparent for decomposition processes with energy thresholds some volts above the parent ion appearance potential, and this is illustrated by data for the ionization efficiencies from the molecules NH_3, C_2H_4, and C_2F_4. Perturbation from such competitive processes can result in erroneously high measured appearance potentials for the product ions. (auth)

41407 PHOTOCONDUCTIVITY OF ANTHRACENE. R. Raman, L. Azarraga, and S. P. McGlynn (Louisiana State Univ., Baton Rouge). J. Chem. Phys., 41: 2516-23 (Oct. 15, 1964). (TID-20692)

The transport properties of current carriers in anthracene were studied by a crystal counter technique. It is shown that the charge pulses may be analyzed as the sum of two contributions, a primary component that varies linearly with time and that breaks at a time equal to the transit time, and a secondary component that is caused by slow release of holes from traps in the surface region. Analysis of both components leads to carrier mobilities, thermal dependence of carrier mobilities, and of carrier populations, surface trap depths, etc. The interpretation of pulse height vs voltage behavior, which is superlinear, invokes recombination and/or detrapping processes that are field-dependent. Experiments are presented that show that recombination at the surface is kinetically more important than recombination in the bulk. It is indicated that the photogeneration of charge carriers at the irradiated surface may be biphotonic. (auth)

41408 THE MAGNETIC AND SPECTRAL PROPERTIES OF SOME URANIUM(IV) COMPLEXES. K. W. Bagnall, D. Brown, and R. Colton (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). J. Chem. Soc.: 2527-30 (Aug. 1964).

A uranium tetrathiocyanate-NN-dimethylacetamide (DMA) complex, $U(SCN)_4$,4DMA, and tetrapotassium octaisothiocyanate, $K_4U(NCS)_8$, were prepared. Their magnetic properties and absorption spectra, and those of the analogous chloride, nitrate, and perchlorate amide complexes, were investigated. The attempted preparation of a uranium tetracyanide-DMA complex gave inconclusive results. (auth)

41409 SOME ACETAMIDE COMPLEXES OF THE ACTINIDE TETRACHLORIDES. PART II. THORIUM. K. W. Bagnall, D. Brown, P. J. Jones, and P. S. Robinson (United Kingdom Atomic Energy Authority). J. Chem. Soc.: 2531-4(Aug. 1964).

Thorium tetrachloride forms a complex with N,N-dimethylacetamide (DMA), of composition $ThCl_4$,4DMA, from which the corresponding nitrate [$Th(NO_3)_4$,2.5DMA], thiocyanate [$Th(SCN)_4$,4DMA], and perchlorate [$Th(ClO_4)_4$, 6DMA] complexes were prepared. The perchlorate complex, like the uranium(IV) analogue, forms a trihydrate. The tetrachloride complex loses dimethylacetamide when heated under a vacuum, giving products with three (160–204°), two (212–236°), and one (340–400°) molecule of dimethylacetamide, the last molecule being lost above 412°C. A uranium tetrachloride-N-methylacetamide (NMA) complex, UCl_4,4NMA, was also prepared. (auth)

41410 OXIDATIONS OF ORGANIC COMPOUNDS BY COBALTIC SALTS. PART V. KINETIC AND PRODUCT STUDIES, AND ISOTOPE EFFECTS IN THE OXIDATION OF SECONDARY ALCOHOLS. D. G. Hoare and W. A. Waters (Oxford Univ.). J. Chem. Soc.: 2560-5(Aug. 1964).

Cobalt perchlorate concurrently oxidizes secondary alcohols by two routes, $RCOR' \xleftarrow{a} RR'CH{\cdot}OH \xrightarrow{b} R'CHO + R$ the ease of elimination of an alkyl group other than methyl being comparable or greater than the ease of oxidation by route (a). With alcohols RR'CD·OH both product studies and rate measurements revealed that these oxidations exhibit kinetic isotope effects, but concordance between the two sets of measurements is not clearly apparent. Suggestions are advanced concerning the reaction mechanism. (auth)

41411 SOME CHLOROURANATE(V) AND CHLOROTUNGSTATE(V) COMPOUNDS. K. W. Bagnall, D. Brown, and J. G. H. du Preez (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Chem. Soc.: 2603-8 (Aug. 1964).

Hexachlorouranate(V) compounds of the type M^IUCL_6 ($M^I = Cs^+$, Me_4N^+, $Me_2H_2N^+$, and Ph_4As^+), and some analogous tungsten(V) salts ($M = Cs^+$, Me_4N^+, and Et_4N^+), were prepared from thionyl chloride solutions of uranium pentachloride and tungsten hexachloride, respectively. The octachlorouranate(V) compound $(Me_4N)_3UCl_8$ was also isolated, and evidence for the heptachlorouranate(V) anion UCl_7^{2-}, in thionyl chloride solution, was obtained by conductometric titration. The magnetic, crystallographic, and spectral properties of the compounds are reported. (auth)

41412 NEPTUNIUM AND PLUTONIUM TRIOXIDE HYDRATES. K. W. Bagnall and J. B. Laidler (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Chem. Soc.: 2693-6(Aug. 1964).

Neptunium trioxide di- and mono-hydrates, $NpO_3,2H_2O$ and NpO_3,H_2O, were prepared by ozone oxidation of aqueous suspensions of neptunium(V) hydroxide at 18 and 90°C, respectively; thermal decomposition of the monohydrate above 300°C yielded the black pentoxide, Np_2O_5. Oxidation of plutonium(IV) hydroxide under the same conditions yielded $PuO_3,0.8H_2O$; uranium(IV) hydroxide and U_3O_8 behave in a similar manner, both yielding $UO_3,0.8H_2O$. (auth)

41413 NEPTUNIUM PENTOXIDE. Donald Cohen and A. J. Walter (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Chem. Soc.: 2696-9(Aug. 1964).

Neptunium pentoxide, Np_2O_5, was characterized, and its symmetry determined by x-ray powder methods. (auth)

41414 THE MECHANISM OF OXIDATION OF CYCLOHEXANONE UNDER ACID CONDITIONS. PART III. CORRECTED ENOLIZATION RATES AND KINETIC ISOTOPE EFFECTS. A. J. Green, T. J. Kemp, J. S. Littler, and William A. Waters (Oxford Univ.). J. Chem. Soc.: 2722-6(Aug. 1964).

New measurements show that the zeroth-order rates of bromination, iodination, and mercuric perchlorate oxidation of cyclohexanone are closely similar. The kinetic isotope effects for these three reactions were measured for tetra α-deuterocyclohexanone. The isotope effects for both tritiation and detritiation of cyclohexanone were measured by scintillation counting of samples of cyclohexanone oxime. These results accord with theoretical predictions. (auth)

41415 ULTRAVIOLET SPECTRA OF THE ALKYL CYANIDE COMPLEXES OF TITANIUM(IV) AND ZIRCONIUM(IV) HALIDES. G. W. A. Fowles and R. A. Walton (Univ. of Southampton, Eng.). J. Chem. Soc.: 2840-1 (Aug. 1964).

The ultraviolet spectra of the methyl and ethyl cyanide adducts of titanium and zirconium tetrachlorides and tetrabromides were measured in the appropriate cyanide and the results are reported. All the peaks have extinction coefficients greater than 1000, and must be associated with the transfer of charge from the ligand π-orbitals to the metal d-levels. A comparison of the band 1 peaks (45,000 cm^{-1} region) for corresponding chloride and bromide complexes shows a large red shift from chloride to bromide; a similar shift is observed for the tetrahalides themselves. The various types of transitions observed in the spectra are discussed. (P.C.H.)

41416 REACTIONS OF NIOBIUM(V) AND TANTALUM(V) CHLORIDES AND BROMIDES WITH ALKYL CYANIDES. K. Feenan and G. W. A. Fowles (Univ. of Southampton, Eng.). J. Chem. Soc.: 2842-3(Aug. 1964).

The reactions of quinquevalent niobium and tantalum bromides and chlorides with ethyl, methyl, and propyl cyanides are reported. All four halides readily dissolve in excess of alkyl cyanide and removal of the excess solvent results in the deposition of crystalline 1 : 1 adducts that are diamagnetic and thus contain quinquevalent Nb and Ta. Conductance measurements on solutions of a selection of the adducts in excess of alkyl cyanide showed that they are non-electrolytes. Ebullioscopic measurements on benzene solutions of nine of the compounds showed that they are monomeric. Analytical data for the MX_5,RCN complexes are tabulated. (P.C.H.)

41417 A POLAROGRAPHIC STUDY OF URANYL-SULFOSALICYLATE COMPLEX. Tong-ming Hseu (National Taiwan Univ., China). J. Chinese Chem. Soc. (Taiwan), 6: 26-37(Sept. 15, 1959).

Polarographic studies of uranyl perchlorate in the presence of an excess of sulfosalicylate gave information on the complex formation of the 1 : 1 uranyl sulfosalicylate at pH 4.68, corresponding to the reaction: U(VI): sulfosalicylate + H^+ + e $\rightarrow$ U(V): sulfosalicylate. Above pH 4.9, however, the polarographic wave split into two reduction waves, which may be attributed to the dissocation of the complex and the reduction of U(VI) to U(V) and U(V) to U(VI). (auth)

41418 PAPER ELECTROPHORETIC STUDIES OF THE ELECTROLYTIC BEHAVIOR OF QUADRIVALENT METAL IONS. Kuan Pan, Wen-kuei Wong, and Shu-chi Chiang (National Taiwan Univ., China). J. Chinese Chem. Soc. (Taiwan), 7: 85-101(Dec. 15, 1960).

The electrical migration of tetravalent metal ions, Ge(IV), Ti(IV), Zr(IV), Th(IV), and U(IV) was observed by means of paper electrophoresis, using tartaric acid and tartrate or acetic acid and acetate buffers as background electrolytic solutions. These metals formed negatively charged complex ions with the tartrate that migrated toward the anode, but not with the acetate, except for the U(IV) ion, which was gradually oxidized to UO_2^{+2} ion and then formed complexes with the acetate. The ratio of ionic radii of tartrate complexes was approximately estimated from the ratio of their migration distances under the same conditions. (auth)

41419 CATHODIC ACTION OF THE URANIUM CHELATE COMPOUNDS AT THE DROPPING MERCURY ELECTRODE. I. URANYL-SUCCINATE COMPLEX. Tsai-teh Lai and Teh-liang Chang (Cheng Kung Univ., Tainan, Taiwan, China). J. Chinese Chem. Soc. (Taiwan), 7: 114-23(Dec. 15, 1960).

Complex formation between uranium(VI) and succinic acid was studied polarographically. The first wave of the chelate in a pH range from 2.0 to 6.5 is discussed. The difference of ligands between U(VI) and U(V) was found to be two, and the electrode reactions at $2.0 < pH < 5.2$ and $5.2 < pH < 6.5$ were considered to be $UO_2(Suc)_n^{-2n+2} + H^+ + e = UO_2(Suc)_{n-2}^{-2n+5} + HSuc^- + Suc^{2-}$ and $UO_2(Suc)_n^{-2n+2} + e = UO_2(Suc)_{n-2}^{-2n+5} + 2Suc^{2-}$, respectively. The dissociation constants at 30°C were calculated to be $[UO_2(Suc)_{n-2}^{-2n+6}][HSuc^-][Suc^{2-}]/[UO_2(Suc)_n^{-2n+2}][H^+] = 19.2$ and $[UO_2(Suc)_{n-2}^{-2n+6}][Suc^{2-}]^2/[UO_2(Suc)_n^{-2n+2}] = 3.69 \times 10^{-6}$. A linear relation was found to exist between the diffusion current and uranyl ion concentration in a range between 2×10^{-4}M to 3×10^{-3}M. (auth)

41420 CATHODIC ACTION OF THE URANIUM CHELATE COMPOUNDS AT THE DROPPING MERCURY ELECTRODE. II. URANYL-GLUTAMATE COMPLEX. Tsai-teh Lai, Teh-liang Chang, and Hua Chang (Cheng Kung Univ., Tainan, Taiwan, China). J. Chinese Chem. Soc. (Taiwan), 8: 23-32(Mar. 1, 1961).

The polarographic behavior of a tridentate chelate compound of uranyl glutamate was investigated over the pH range of 1.5 to 5.5. The first wave of one-electron reduction and diffusion-controlled reversible wave was applied through this pH range. Below pH 1.9 there was no chelation, and above pH 5.5 turbidity ensued. At pH 3.0 to 3.9 the diffusion current was independent of pH value and the diffusion current constant was calculated to be 2.08. The proportionality between uranyl ion concentration and diffusion current held within the narrow range of 2.2×10^{-4} to 3.3×10^{-3}M with 1.9% average deviation of the mean. The chelate forms and electrode reactions identified from the half-wave potential and diffusion current data were: pH 4.4 to 5.5, $UO_2(G)_2^{2-} + e = UO_2^+ + 2G^{2-}$; pH 3.0 to 4.4, $UO_2(HG)_2 + H^+ + e = UO_2(HG) + H_2G$; and pH < 1.9, $UO_2^{2+} + e = UO_2^+$. (auth)

41421 PHYSICO-CHEMICAL STUDIES OF HINOKITIOL. IV. SPECTROPHOTOMETRIC STUDY OF THE CHELATE COMPOUNDS OF THE GROUP IVB METALS WITH HINOKITIOL. Tong-ming Hseu (National Taiwan Univ., China). J. Chinese Chem. Soc. (Taiwan), 8: 33-50 (Mar. 1, 1961).

Stability constants of titanium(IV), zirconium, and thorium hinokitiolate chelates were calculated from spectrophotometric data in 50% ethanol-water solution at 25°C. It was found that the stability constant and the optimum pH of the various metal chelates increase with increasing atomic number of the metals. The order of stability for the metals was the same as that found for other types of coordinating agents. Zirconium and thorium combined with four hinokitiolate ions, while titanium(IV) combined with only two hinokitiolate ions to form a chelate compound. A list of molar absorption coefficients is given and the photometric sensitivities of these metals with hinokitiol were determined. (auth)

41422 OXIDATION POTENTIAL OF THE CEROUS-CERIC ELECTRODE IN DILUTE SULFURIC ACID SOLUTIONS. Kuan Pan, Kai-tee Hsieh, and Chen-hanson Ting (National Taiwan Univ., China). J. Chinese Chem. Soc. (Taiwan), 8: 147-55(Sept. 30, 1961).

The oxidation potential of the Ce(III)-Ce(IV) couple in sulfuric acid over the concentration range of 0.05 to 0.5 F was observed at 25°C by using the $Pt-PbO_2/PbSO_4, SO_4^{=}$ electrode as the reference. The free energy change for the reaction $2Ce^{+3} + PbO_2 + 4H^+ + SO_4^{=} = 2Ce^{+4} + PbSO_4 + 2H_2O$ was estimated. (auth)

41423 POTENTIOMETRIC STUDIES ON THE BINDING OF BERYLLIUM, STRONTIUM, THORIUM, AND MAGNESIUM BY GELATIN. Salahuddin and Wahid U. Malik

(Muslim Univ., Aligarh, India). J. Indian Chem. Soc., 41: 362-4(May 1964).

Potentiometric studies on the binding of beryllium, strontium magnesium, and thorium by gelatin, carried out at the total ionic strength of 0.15, provided evidence for the binding of Be^{2+}, Sr^{2+}, and Th^{4+} through the carboxyl groups of the protein; no such information is available in the case of magnesium. (auth)

41424 A KINETIC STUDY OF THE OXIDATION OF MALONIC ACID BY CERIUM(IV). R. L. Yadav and W. V. Bhagwat (Holkar Science Coll., Indore, India). J. Indian Chem. Soc., 41: 389-93(May 1964).

The kinetics of oxidation of malonic acid by cerium(IV) in sulfuric acid medium was found to be of first order with respect to each reactant. The first-order rate constant was found to vary inversely as sulfuric acid concentration. The Arrehenius equation was found to be valid between 20 and 30°C. The values for the energy of activation, entropy of activation, frequency factor, and temperature coefficient were found to be 11.962 g cal/mole, −19.24 cal/MÅ, 4.124×10^8 sec^{-1}, and 1.961 respectively. The experimental findings are consistent with the fact that the mechanism involves the rapid formation of complex by the reactant, which slowly decomposes to provide Ce(III) and free radical. The active free radical was found to be as $CH(CO_2H)_2$, capable of oxidizing formic, acetic, and succinic acids, which are not oxidized by Ce(IV). The reaction mechanism on the basis of induced radical oxidation and of a simple method of quantitative estimation of formic acid in the presence of inorganic salt is suggested. (auth)

41425 FUNDAMENTALS FOR COMPLEX FORMATION WITH CATIONS AS LIGANDS. K. H. Lieser (Technische Hochschule, Darmstadt, Ger.). J. Inorg. Nucl. Chem., 26: 1571-5(Sept. 1964). (In German)

The experimental detection of the formation of complex compounds with cations as ligands in solution and the assumptions for the origin of this type of complexes in solution and in the solid state are discussed. (tr-auth)

41426 THERMAL DECOMPOSITION OF URANYL NITRATE HEXAHYDRATE IN THE PRESENCE OF GRAPHITE. Kazumi Iwamoto (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 1: 113-19(July 1964).

An attempt was made to pursue the course of the thermal decomposition of uranyl nitrate hexahydrate in the presence of graphite, and compositions of the product at various stages in the decomposition were determined by x-ray diffraction and by thermogravimetric measurement. The influence of graphite on the decomposition appeared in the temperature region above 500°C, and reduction with graphite of the decomposed product into uranium dioxide was observed above 750°C. It was also demonstrated that uranium dioxide and carbide-dispersed graphite-base fuel could be prepared by thermal decomposition of hexahydrate in the graphite matrix. (auth)

41427 PRELIMINARY OBSERVATIONS OF SINGLE CRYSTALS OF UO_2 BY TRANSMISSION ELECTRON MICROSCOPE. Shoichi Nasu and Ryuzo Ueda (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 1: 141-2(July 1964).

Transmission electron microscope results observed on single crystals of arc-fused UO_2 are reported. In a crystal with foil plane parallel to (111), hexagonal pits were observed but no contrasts due to dislocations. Contrasts were frequently observed in crystals with foil plane parallel to (110). These are possibly dislocations. A sudden increase in the electron-beam current is sometimes sufficient to create dislocations lying perpendicular to the foil plane in the vicinity of the crystal edges. An intense electron beam current is sufficient to evaporate and melt the thinner regions because of the low thermal conductivity of this material at relatively high temperature. (P.C.H.)

41428 FLUORESCENCE QUANTUM EFFICIENCY OF RARE-EARTH CHELATES. M. L. Bhaumik and C. L. Telk (Electro-Optical Systems, Inc., Pasadena, Calif.). J. Opt. Soc. Am., 54: 1211-14(Oct. 1964).

Fluorescence quantum efficiency of several β-diketone chelates of Tb^{3+}, Eu^{3+}, and Sm^{3+} in solutions were measured at 300°K. The highest quantum yield of the solutions investigated was found to be approximately 50%. The quantum efficiency was found to be dependent on the nature of the solvent, but is fairly independent of the wavelength of excitation, or the presence of oxygen. The fluorinated chelates, in general, have higher quantum yield in solutions, and therefore may be considered as possible material for liquid laser operation near room temperatures. The high quantum yield of the fluorinated chelates in solution also indicates that the time required for energy transfer in the chelates is at least an order of magnitude less than the time required for oxygen quenching in the triplet state. (auth)

41429 ISOTOPIC SHIFTS OF URANYL FREQUENCIES. Llewellyn H. Jones (Los Alamos Scientific Lab., N. Mex.). J. Opt. Soc. Am., 54: 1283-4(Oct. 1964). (LADC-6457)

The harmonic frequencies and the corresponding frequencies for the fundamental transitions in $^{16}OU^{18}O$ and $U^{18}O_2$ were calculated. It was concluded that for uranyl complexes the force constants of the linear UO_2 group can be calculated to a good approximation by neglecting the ligands and treating it as a triatomic molecule. Data are tabulated. (P.C.H.)

41430 CHEMICAL BINDING IN DIATOMIC HYDRIDE MOLECULES. Edgar M. Layton, Jr. and Klaus Ruedenberg (Ames Lab., Ames, Iowa). J. Phys. Chem., 68: 1654-76(July 1964). (IS-747)

The partitioning of the rigorous quantum mechanical energy was applied to minimal basis LCAO−SCF−MO (linear combination atomic orbitals−molecular orbitals−self consistent fields) wave functions of the hydrides LiH, BH, NH, and FH in order to examine the quantitative variations of the defined energy fragments over a series of comparable wave functions of similar molecules. The variations found exhibited clear trends, but were not of extreme simplicity, since even in these small systems, a variety of factors influenced the energetic balance. Four main factors could be discerned. A characteristic difference existed in the population of the σ-valence molecular orbitals. Only the bonding (2σ) MO was occupied in LiH and NH, but in BH and FH the slightly antibonding (3σ) was occupied as well. The progression in nuclear charge from Li to F resulted in a steadily increasing electronegativity. The state of NH analyzed, viz., $(N1s)^2(2\sigma)^2(2\pi)^2(2\bar{\pi})^2$, was an excited state with an empty low-lying (3σ) orbital and, hence, the valence electrons were not as well shielded from the heavy nucleus in NH as they were in BH and FH. They were therefore subject to a particularly high electronegativity. The number of lone-pair electrons, giving rise to nonbonded repulsions, increased from zero in LiH to six in FH. The effect of the σ-orbital occupation was exhibited by the determination of valence hybrid atomic orbitals. In each heavy atom, there was a σ lone-pair hybrid and a σ-bonding hybrid. The latter always contained an average of about one electron, the former was found empty in LiH and NH and doubly occupied in BH and FH. Whereas, LiH and NH, the bonding hybrid had largely s-character (>80% s,

<20% p) and the lone pair had largely p-character (<20% s, >80% p, for orthogonality reasons), the composition of the two hybrids was reversed in BH and NH. The composition in LiH and NH was considered to be optimal for a bonding orbital, representing a compromise between s-p promotion and energy lowering by interference through increased overlap with hydrogen. However, in BH and FH, a lower over-all energy was achieved when most of the low-energy s-orbital was used by the lone pair, since it was more heavily populated and, not being involved in overlap effects, did not benefit from p admixture. The quasi-classical electrostatic interactions, while slightly attractive in all cases, were somewhat higher in LiH and BH, which had the larger p-content in the bonding atomic hybrid. The progression in electronegativity along the series was reflected in electron-sharing terms as well as in the charge-transfer terms. Charge transfer to the heavy atom increased steadily from Li (−0.3 electron) over B (no transfer) to F (0.23 electron). It was much larger in N (0.6 electron) because the empty low-energy σ-orbital weakened the shielding. The positive sharing penetration energy and the negative sharing interference energy, both, also increased in magnitude, since the heavy-atom orbitals contracted from Li to F, thereby magnifying all kinetic and potential interactions in which they were involved. The increase in the strong interference between the bonding hybrid and the hydrogen was the main reason for the increase in binding energy along the series. However, since the slightly antibinding interference between the lone-pair hybrid and hydrogen rose similarly, no relative shortening of the bond occurs; in fact, the decrease in bond length from Li to F was slightly less than the shrinkage in orbital diameters. Correspondingly, overlap decreased slightly, and bond orders and valence-active populations remained approximately constant. In all cases, where contractive promotion was allowed for in the wave function, it furnished the substantial potential energy lowering characteristic for the binding energy. The corresponding kinetic energy increase arising from contractive promotion was offset by the large negative value of the kinetic interference energy. The essential feature of the binding process was therefore again the interplay between constructive interference and contractive promotion, within the limitations of the virial theorem. (auth)

41431 CHEMICAL BINDING IN HOMONUCLEAR DIATOMIC MOLECULES. Rolland R. Rue and Klaus Ruedenberg (Ames Lab., Ames, Iowa). J. Phys. Chem., 68: 1676-1706(July 1964). (IS-746)

The quantum mechanical energies obtained from minimal basis set LCAO−MO−SCF (linear combination atomic orbitals−molecular orbitals−self consistent fields) wave functions for the molecules Li_2, Be_2, C_2, N_2, and F_2 were analyzed by means of a partitioning, in order to examine the individual energy contributions in a series of molecules which, though related, differ substantially in the electronic distribution. In Be_2 and C_2, one binding σ_g-MO and one antibinding σ_u-MO were doubly occupied, a situation equivalent to a nonbonding lone pair on each of the two atoms. In Li_2, N_2, and F_2, on the other hand, there was one occupied bonding σ_g-MO uncompensated by an antibonding σ_u-MO; N_2 and F_2 had in addition, the equivalent to a nonbonding lone pair on each atom. The valence σ-atomic orbitals were again a bond hybrid and a lone-pair hybrid. In Li_2, with no lone-pair electrons, it was the bond hybrid which had mainly s-character and only little p admixture; but in the other molecules, the lone-pair hybrid was populated by two electrons and, hence, had mainly s-character, in analogy to similar observations in the hydrides. The quasi-classical electrostatic energy absorbed a considerable amount of cancellation between large positive and negative potential terms, the over-all effect being relatively small in most cases. The attractive interactions were: (bond hybrid)′ − (bond hybrid)″; (bond hybrid)′ − (lone-pair hybrid)″; and (bond hybrid)′ − (π-atomic orbital)″. The repulsive interactions were: (lone-pair hybrid)′ − (lone-pair hybrid)″; (lone-apir hybrid)′ − (π-AO)″; and (π-AO)′ − (π-AO)″. (The primes ′ and ″ denote the two atoms.) The signs of the electrostatic potential energies were due to the geometrical shapes of the valence atomic orbitals, in particular their polarizations. The magnitudes were largely determined by the orbital populations and by the frequency with which individual interactions occurred (the interaction (bond AO)′ − (bond AO)″ occurred once, the interaction (lone-pair AO)′ − (π-AO)″ occurred four times, etc.). As in the case of the quasi-classical interactions, several types of sharing interference contributions were found. As a general rule, they were binding (negative) between those valence atomic orbitals that had populations less than or equal to two, i.e., (bond hybrid)′ − (bond hybrid)″ and (π-AO)′ − (π-AO)″ in C_2 and N_2. They were nonbinding (slightly positive) between doubly occupied valence atomic orbitals: (lone-pair hybrid)′ − (lone-pair hybrid)″ and (π-AO)′ − (π-AO)″ in F_2. They were antibinding (positive) between a valence atomic orbital of population two and another of population less than or equal to one, i.e., (lond-pair hybrid)′ − (bond-hybrid)″. They practically vanished for two valence atomic orbitals of different symmetry. These rules applied to the ground state. Deviations from the pattern appeared to occur when, due to inadequacies in the wave function, the deviations from the virial relationship between potential and kinetic energy became too large, as in Li_2 and particularly in Be_2 and C_2. While most interference terms corresponded to the simple constructive and destructive prototype encountered in the hydrides, two different modifications were found here because of the greater variety in shapes among the L-shell orbitals. The magnitudes of the different terms were determined by bond orders and by the frequency of occurrence. The sharing penetration contributions paralleled closely the sharing interference terms. Where constructive interference yielded binding effects, interatomic sharing penetration lowered the energy, and where destructive interference yielded antibinding effects, interatomic sharing penetration increased the energy. These interatomic contributions were more than compensated by corresponding intra-atomic sharing penetration effects of opposite sign, so that the total penetration energies were positive in all cases, expressing the increase in electronic repulsion resulting from electron sharing. An over-all contractive promotion was found, which furnished the majority of the potential energy lowering associated with molecule formation. The kinetic energy increase, due to contractive promotion, was compensated by the kinetic energy depression through interference. Thus, the interplay between these two effects was again found to be characteristic for the binding process. (auth)

41432 GRAPHITIC OXIDE. VI. SOME PHYSICO-CHEMICAL PROPERTIES. J. H. de Boer and A. B. C. van Doorn. Koninkl. Ned. Akad. Wetenschap., Proc., Ser. B, 64: 34-40(1961).

The swelling of graphitic oxide by adsorption of water was investigated by determining the density of anhydrous graphitic oxide and of samples containing water in benzene. The density of anhydrous graphitic oxide in several other inhibition liquids was also determined. (D.C.W.)

41433 MOLECULAR STRUCTURE INVESTIGATIONS WITH THE MÖSSBAUER EFFECT. J. Danon (Centro

Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Centro Brasil. Pesquisas Fis., 10: 331-8(1963).

Studies were made on the nuclear isomer shift and nephelauxetic effect in iron complexes, electronic structure of Fe–NO complexes by the Mössbauer effect, and Mössbauer effect with trivalent iron halides in different molecular symmetries. In spin-paired iron complexes such as with Cl, the contribution of π-bonding to the isomer shift (I.S.) (by decreasing s-electron shielding) appears so strong that it breaks the parallelism between I.S. and the nephelauxetic effect (N.E.). It is shown that the decrease in s-electron shielding as a consequence of the delocalization of d-electrons in the π-bond is larger than that due to the removal of a d-electron from the iron atom. The NO ligand has an unpaired electron that can expand in a M. O. formed with the d orbitals of a transition ion. Evidence is given to support the assumption that in $Fe(CN)_5NO^{2-}$ the unpaired d electron of low-spin Fe^{3+} couples with the unpaired electron of NO, both electrons being delocalized in a strong π-bond. It is believed that in Fe^{3+} hydrated halides (and amines) some of the halogens, if not all, are directly bonded to the iron atom forming a low symmetry structure. (P.C.H.)

41434 THE DEPOSITION OF THIN FILMS OF RED PHOSPHORUS. B. W. Hooton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Instr. Methods, 27: 338(July 1964).

A method for obtaining thin films of red phosphorus is described. Phosphorus is evaporated in the presence of a red-hot tungsten filament, which prevents the formation of yellow phosphorus. (auth)

41435 WORK ON THE SYNTHESIS OF XENON AND FLUORINE BINARY COMPOUNDS. Joze Slivnik (Nuclear Institute "Jozef Stefan," Ljubljana, Yugoslavia). Nukl. Enerija, 1: 15-16(July 1964). (In Yugoslavian)

The results of experiments on the separation of xenon-tetrafluoride and xenon-hexafluoride are described. The conditions of work are stated as well as some characteristics of the apparatuses. The chemical analysis and pressure measurements indicate the possibility of the existance of xenon-octafluoride. (P.C.H.)

41436 THE HYPERSENSITIZING EFFECT OF TRIETHANOLAMINE ON NUCLEAR EMULSIONS. E. Ranz (Technische Hochschule, Munich). Phot. Wiss., 11: 16-18 (1962). (In German)

Reasons for the hypersensitization of nuclear emulsions by triethanolamine are discussed. A pH increase of the emulsion film, complex formation with metal ions, a reducing effect, an effect as halogen acceptor, and energy transmission between the gelatin matrix and the Ag halide grains are considered. (M.C.G.)

41437 PACKET-SHIFTING ELECTRON-NUCLEAR DOUBLE-RESONANCE MECHANISMS. E. C. McIrvine, J. Lambe, and N. Laurance (Ford Motor Co., Dearborn, Mich.). Phys. Rev., 136: A467-73(Oct. 19, 1964).

Mechanisms of electron-nuclear double resonance (ENDOR) which involve the shift of spin packets are discussed in relation to experiments performed on phosphorus-doped silicon and irradiated frozen sulfuric acid. Both homogeneously saturated and inhomogeneously saturated electron-paramagnetic-resonance (EPR) transitions are considered. In the case of homogeneous packet-shifting ENDOR, the presence or absence of certain relaxation paths determines the sign and size of the ENDOR response. In the case of inhomogeneous packet-shifting ENDOR, the saturation and passage conditions also determine the nature of the ENDOR response. (auth)

41438 PRODUCTION OF URANIUM, THORIUM, AND PLUTONIUM AND THEIR COMPOUNDS. Reactor Fuel Process., 7: No. 3, 214-22(1964).

Preparation of uranium dioxide, uranium carbides, plutonium dioxide, uranium, plutonium carbides, and plutonium is discussed along with the reduction of uranium trioxide, conversion of uranium hexafluoride to uranium dioxide, sinterability of uranium dioxide and uranium carbides, synthesis of uranium monocarbide from uranosic oxide, ceramic coating of uranium carbides, and reduction of plutonium dioxide. (42 references). (N.W.R.)

41439 THE TERNARY SYSTEM: CARBON TETRACHLORIDE–WATER–TRIBUTYL PHOSPHATE (TBP). J. J. Van Aartsen and A. E. Korvezee (Technische Hogeschool, Delft, Netherlands). Rec. Trav. Chem., 83: 752-63 (July 1964).

Studies were made on the extraction equilibria in the tertiary system CCl_4–TBP–H_2O. From the three binaries that limit this system the pairs TBP–H_2O and CCl_4–H_2O have a miscibility-gap, while the pair TBP–CCl_4 is fully miscible. The extremely asymmetric miscibility-gap in the system water-tributyl phosphate (TBP) has given rise to the assumption that a compound with composition $H_2O \cdot$ TBP is formed. The freezing point diagram and some solubility data in this system were measured as a function of temperature. From the results, it was concluded that the compound mentioned does not exist to any appreciable concentration in solutions of water in TBP, although these solutions show an appreciable deviation from ideality. This non-ideal behavior was investigated by isopiestic vapor pressure measurements. Data on the activity coefficients of water in TBP are given at 25.0°C. They are represented by the equation $\ln f_{H_2O} = x^2\,[1.563 - 1.143\,(4x - 3) + 0.682\,(2x - 1)\,(6x - 5)]$ x being the mole fraction of TBP. Data on vapor pressures and activity coefficients for the binary TBP–CCl_4 are given at 25.0°C. In the ternary phase diagram the miscibility boundary was determined at the same temperature. (P.C.H.)

41440 COMPOUNDS OF LANTHANUM AND CERIUM WITH PAR (4-(2-PYRIDYLAZO)-RESORCINOL). P. Spacu, Elena Antonescu, and Silvia Plostinaru (Research Inst. for Inorganic Chemistry, Bucharest). Rev. Roumaine Chim., 9: 121-6(Feb. 1964). (In German)

Compounds of rare earths with PAR (4-(2-pyridylazo)-resorcinol) were investigated. On the basis of the methods of Job and Asmus it was proved that compounds with a ratio of 1 : 2 or $[Me(PAR)_2]^-$ are formed in the solution. These formulas were also confirmed by chemical analysis of the solid compounds, which originated in very concentrated solutions. (tr-auth)

41441 COMPARATIVE ELECTROCHEMICAL STUDY OF HYDROGEN AND DEUTERIUM ADSORPTION ON PLATINUM. M. W. Breiter (General Electric Research Lab., Schenectady, N. Y.). Trans. Faraday Soc., 60: 1445-9(Aug. 1964).

The adsorption of hydrogen or deuterium atoms was studied electrochemically on smooth platinum between 0 and 70°C in $1\underline{N}$ H_2SO_4 or $1\underline{N}$ D_2SO_4. Equal treatment of the platinum electrode and equivalent working conditions assured the same surface state for the measurements in $1\underline{N}$ H_2SO_4 and in $1\underline{N}$ D_2SO_4. It was found that the same coverage is present at a slightly smaller equilibrium pressure of deuterium than of hydrogen. The heats of adsorption are equal at a given coverage for hydrogen and deuterium. (auth)

41442 HETEROGENEOUS EXCHANGE OF ISOTOPIC AND NON-ISOTOPIC IONS ON ALKALINE-EARTH SUL-

FATES. II. EXCHANGE EQUILIBRIUM ON ALKALINE-EARTH SULFATE SURFACES. W. Hild and K. H. Lieser (Technische Hochschule, Darmstadt, Ger.). Z. Anorgan. Allgem. Chem., 331: 133-46(Aug. 1964). (In German)

The heterogeneous exchange of isotopic and non-isotopic ions on the surface of alkaline earth sulfates was measured as a function of time. Microcrystalline sulfates were used and their preparation is described. The equilibrium constants for the exchange between Me(II) ions in solution and the ions being, at the start of the experiments, on the surfaces of the sulfates are calculated and discussed. (auth)

41443 FORMATION OF COMPLEX COMPOUNDS BETWEEN URANYL NITRATE AND THE NITRATES OF THE FIRST GROUP ELEMENTS. II. THE SYSTEM: RUBIDIUM NITRATE–URANYL NITRATE–WATER (CONDUCTIVITY, REFRACTIVE INDEX, COLORIMETRY AND pH). S. S. Gupta and B. N. Sharga (Lucknow Univ., India). Z. Anorgan. Allgem. Chem., 331: 216-19(Aug. 1964).

Refractive index, colorimetry, conductivity, and pH measurements of a series of mixed solutions of uranyl nitrate and rubidium nitrate showed the existence of three complex compounds in solution in the (1:1), (1:2) and (1:3) molecular ratios, respectively as $UO_2(NO_3)_2 \cdot RbNO_3$, $UO_2(NO_3)_2 \cdot 2RbNO_3$, and $UO_2(NO_3)_2 \cdot 3RbNO_3$. The three compounds were detected only in the solution by the breaks in the usual curves when various properties like conductivity, refractive index, colorimetry, and pH were plotted against the ml of rubidium nitrate (M/20) added to a fixed volume of uranyl nitrate (M/20). (auth)

41444 ASSOCIATION OF URANYL, LEAD AND MERCURY(II) IONS WITH ACETATE IN AQUEOUS SOLUTION. D. Banerjea and I. P. Singh (Regional Engineering Coll., Durgapur, West Bengal, India). Z. Anorgan. Allgem. Chem., 331: 225-30(Aug. 1964).

The formulas and formation constants of the mononuclear complexes formed by uranyl, lead, and mercury(II) ions with acetate were determined graphically by a pH method, at 30°C in sodium perchlorate medium of unit ionic strength. The results indicate strong complexation of uranyl and mercury(II) ions with acetate; in these cases all the four complexes with metal:acetate ratio up to 1:4 were characterized. Lead ion forms a moderately stable 1:1 complex and a relatively weaker 1:2 species. In the case of uranyl and lead ions complexes higher than those mentioned above also appear to be formed, though not to any appreciable extent, under the experimental conditions. (auth)

41445 THERMAL DISSOCIATION OF OSMIUM TRICHLORIDE. N. I. Kolbin, I. N. Semenov, and Yu. M. Shutov (Leningrad State Univ.). Zh. Neorgan. Khim., 9: 1029-31(May 1964). (In Russian)

Thermodynamic characteristics and dissociation pressures of $OsCl_3$ were measured at 726 to 913°K. For the reaction $Os_s = \frac{3}{2} Cl_{2g} \rightarrow OsCl_{3s}$ the $\Delta H^0_{812^\circ} = -43.1 \pm 1.0$ kcal/mole and $\Delta H^0_{298^\circ} = 45.5 \pm 2$ kcal/mole. Thermal dissociation pressure of $OsCl_3$ at 831°K is one atmosphere. The standard entropy $S^0_{298^\circ}$ for solid $OsCl_3$ is 31.2. Stable condensed phases of $OsCl_3$ were formed at 450 to 640°C, with chlorine pressures of 6 atm. (R.V.J.)

41446 INFRARED ABSORPTION SPECTRA OF ACETATE OF THE GROUP III METALS ON THE PERIODIC TABLE AND OF THEIR HYDRATES. A. I. Grigor'ev and V. N. Maksimov (Moscow State Univ.). Zh. Neorgan. Khim., 9: 1060-5(May 1964). (In Russian)

Infrared absorption spectra of Al, Ce, Er, La, Nd, Sc, Y, and Yb anhydrous acetates were analyzed and compared with the spectra of hydrated acetates. The results showed that the thermal decompositions of $La(CH_3COO)_3 \cdot 1.5\ H_2O$, $Ce(CH_3COO)_3 \cdot 1.5\ H_2O$, and $Nd(CH_3COO)_3 \cdot 4\ H_2O$ are identical, forming intermediate 1:1 hydrates. The valence oscillation frequencies in the spectra of hydrated Y, Er, and Yb acetates do not differ from the respective frequencies of anhydrous salts. Variations of valence frequencies in C–O bonds were plotted as functions of ion radius. (R.V.J.)

41447 REACTION OF GADOLINIUM PHOSPHATE WITH PHOSPHORIC ACID. I. V. Tananaev and S. M. Petushkova. Zh. Neorgan. Khim., 9: 1094-8(May 1964). (In Russian)

Solubility in $GdPO_4-H_3PO_4-H_2O$ was studied at 25°C. Preparations of $4\ GdPO_4 \cdot H_3PO_4 \cdot 8\ H_2O$ (with H_3PO_4 concentration to 13%) and $GdPO_4 \cdot H_3PO_4 \cdot 3.5\ H_2O$ (with 17 to 19% H_3PO_4) are described. (R.V.J.)

41448 GADOLINIUM PYROPHOSPHATES. I. V. Tananaev and S. M. Petushkova. Zh. Neorgan. Khim., 9: 1099-1102(May 1964). (In Russian)

Reactions of gadolinium chloride with alkali metal pyrophosphates were studied. It is shown that $GdCl_3$ reacts with $Na_4P_2O_7$ to form weakly soluble $Gd(P_2O_7) \cdot 13\ H_2O$. With increased alkali metal pyrophosphate, $Gd_4(P_2O_7)_3 \cdot 13\ H_2O$ is formed then $K\ GdP_2O_7 \cdot 3\ H_2O$. Thermographic and x-ray analyses were made of the compounds. (R.V.J.)

41449 THE $MgAl_2O_4-LaAlO_3$ SYSTEM. N. A. Torpov and N. A. Sirazhiddinov. Zh. Neorgan. Khim., 9: 1300-2 (May 1964). (In Russian)

The constitution diagram for $MgAl_2O_4-LaAlO_3$ is the simple eutectic type without any intermediate compounds or solid solutions. The $MgAl_2O_4$ crystal is of cubic syngony with a melting point at 2100°C. (R.V.J.)

41450 MONOCRYSTALS OF PRASEODYMIUM AND NEODYMIUM SELENIDES. V. I. Kalitin, N. P. Luzhnaya, E. I. Yarembash, and K. A. Zinchenko (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 9: 1302-4(May 1964). (In Russian)

Monocrystals of $PrSe_2$, Nd_2Se_3, and $NdSe_2$ were synthesized by diffusion, and their formulas were verified. An x-ray diffraction analysis indicated crystallization into a tetragonal lattice (D^7_{4h}). A unique rhomboidal Nd_2Se_3 monocrystal was prepared. (R.V.J.)

41451 STABILITY OF COMPLEX CERIUM-GROUP RARE EARTH COMPOUNDS WITH MALIC ACID. N. K. Davidenko. Zh. Neorgan. Khim., 9: 1584-7(July 1964). (In Russian)

A potentiometric method was used for determining the stability of complexes formed by rare earth ions ($^{3+}$La, $^{3+}$Ce, $^{3+}$Pr, $^{3+}$Nd, $^{3+}$Sm, $^{3+}$Eu, and $^{3+}$Gd) with malic acid at pH 2 to 3. The stability constants at ion strength ~0.2 and 25° are: La $(1.1 \pm 0.1) \times 10^4$, Ce $(1.3 \pm 0.2) \times 10^4$, Pr $(1.9 \pm 0.2) \times 10^4$, Nd $(2.8 \pm 0.3) \times 10^4$, Sm $(2.6 \pm 0.2) \times 10^4$, Eu $(2.2 \pm 0.2) \times 10^4$, and Gd $(1.9 \pm 0.3) \times 10^4$. (R.V.J.)

41452 REACTIONS OF PRASEODYMIUM AND NEODYMIUM NITRATES WITH TARTARIC ACID. O. E Zvyagintsev and V. P. Tikhonov (Moscow Inst. of Chemistry and Technology). Zh. Neorgan. Khim., 9: 1588-96(July 1964). (In Russian)

Reactions of Pr and Nd nitrates with tartaric acid were studied for a wide pH range, and the mechanism of rare earth salt reaction with dicarbonic oxyacids was analyzed. It was postulated that the stability constants of Nd and Pr complexes increased as the added chains became shorter.

An analysis was made of the structure and properties of $[PrC_4H_3O_6 \cdot 3H_2O] \cdot 3H_2O$; $[NdC_4H_3O_6 \cdot 3H_2O] \cdot 3H_2O$; $Na\ [PrC_4H_2O_6 \cdot 2H_2O] \cdot 2H_2O$; $Na\ [NdC_4H_2O_6 \cdot 2H_2O] \cdot 2H_2O$. It was observed that Nd forms much more stable compounds. (R.V.J.)

41453 RARE EARTH COMPLEXES WITH GALLIC ACID. N. S. Polyektov and K. V. Tserkasevich (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zh. Neorgan. Khim., 9: 1606-12(July 1964). (In Russian)

Potentiometric and spectrophotometric analyses of rare earth (La, Ce, Nd, Y, Ho, and Er) complexes with gallic acid showed that at pH 6 they form highly insoluble compounds. In solutions at pH 10 and in 1 N KOH rare earth ions and gallic acid form soluble compounds with a molecular ratio Me : Gal = 1 : 2. Neutral and basic solid solutions with a ratio Me : Gal = 1 : 2 were prepared. (R.V.J.)

41454 PYROPHOSPHATES OF CERTAIN RARE EARTH ELEMENTS AND YTTRIUM. G. I. Vasil'ev and V. V. Serebrennikov. Zh. Neorgan. Khim., 9: 1613-16 (July 1964). (In Russian)

La, Ce, Pr, Nd, Sm, and Gd pyrophosphates ($Ln_4(P_2O_7)_3 \cdot 24H_2O$) and Dy, Er, and Lu pyrophosphates ($Ln_4(P_2O_7)_3 \cdot 36H_2O$, and $Y_4(P_2O_7) \cdot 18H_2O$) were prepared in aqueous solutions at pH 4. The solubility of the phosphates in water at 25° was determined as a function of the rare earth location on the periodical table. (R.V.J.)

41455 INFRARED ABSORPTION SPECTRA OF COMPLEX ZIRCONIUM(IV) COMPOUNDS WITH OXYGEN-CONTAINING ALLOYS. Yu. Ya. Kharitonov, L. M. Zaitsev, G. S. Bochkarev, and O. N. Evstaf'eva (Kurnankov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 9: 1617-23(July 1964). (In Russian)

Infrared absorption spectra were plotted for $H_2ZrO \cdot (C_2O_4)_2 \cdot 3H_2O$, $(NH_4)_2ZrO(C_2O_4) \cdot 3H_2O$, $BaZrO(C_2O_4)_2 \cdot 3H_2O$, $ZrOC_2O_4 \cdot 4H_2O$, $[(ZrO)_2C_2O_4 \cdot 6H_2O]Cl_2 \cdot 7H_2O$, $ZrOO_2 \cdot 2H_2O$, $Zr(OH)_2SO_4 \cdot 4H_2O$, and $ZrOSO_4$. It was found that in the solid state none of the compounds contains any zirconyl groups. (R.V.J.)

41456 REACTIONS OF TANTALUM TRICHLORIDES WITH ALKALI METAL CHLORIDES IN SMELTING. V. V. Safronov, B. G. Korshunov, Z. N. Shevtsova, and S. I. Bakum (Moscow Inst. of Fine Chemical Technology). Zh. Neorgan. Khim., 9: 1687-91(July 1964). (In Russian)

Reactions of tantalum tetrachloride with alkali metal chlorides were studied, and phase diagrams were constructed for $TaCl_3-MeCl$ (Me is Na, K, Rb, and Cs). The existence of Ta as a $[TaCl_5]^{2-}$ ion in $TaCl_3-KCl$, $TaCl_3-RbCl$, and $TaCl_3-CsCl$ systems has been suggested. (R.V.J.)

41457 DIELECTRIC POLARIZATION OF CRYSTAL HYDRATES OF CERTAIN URANYL COMPOUNDS. V. M. Ezuchevskaya, Ya. K. Syrkin, and R. N. Shchelokov (Kurnakov Inst. of Gen. and Inorganic Chemistry at the USSR Acad. of Sciences). Zh. Neorgan. Khim., 9: 1758-9(July 1964). (In Russian)

Measurements of the dielectric polarization of ammonium and sodium uranyl oxalates are tabulated showing the specific weight, dielectric penetrability, molecular volume, total polarization, polarization changes per one molecule of separated water molecule, and variations in molecular volume per one water molecule. (R.V.J.)

41458 ROENTGENOGRAPHIC STUDIES OF SCANDIUM BROMIDE. A. A. Men'kov and L. N. Komissarova. Zh. Neorgan. Khim., 9: 1759-60(July 1964). (In Russian)

Studies were confined to the elementary nucleus of $ScBr_3$. It is shown that anhydrous scandium bromide crystallized into a rhombohedric lattice of $FeCl_3$-type structure: $a = 7.337 \pm 0.005$ kX, $\alpha = 53°50' \pm 5'$, $z = 2$, with the corresponding hexagonal nucleus parameters: $a = 6.643 \pm 0.05$ kX, $c = 18.765 \pm 0.010$ kX, $c/a = 2.825$, $z = 6$. The x-ray density of $ScBr_3$ is 3.93 g/cm^3 and the picnometric density is 3.91 g/cm^3. (R.V.J.)

41459 REACTIONS OF ZIRCONIUM WITH COMPLEXONES. L. N. Pankratova, L. G. Vlasov, and A. V. Lapitskii (Moscow State Univ.). Zh. Neorgan. Khim., 9: 1763-5(July 1964). (In Russian)

Studies were made of Zr reactions with aminoacetic, iminodiacetic, nitrilotriacetic, and ethylenediaminetetraacetic acids. Reactions with nitrilotriacetic and ethylenediaminetetraacetic acids at pH2 formed zirconium complexes with molar ratios of zirconium : acid equal to 1 : 2. Iminodiacetic acid with zirconium at pH 2 formed zirconium complex with zirconium : acid ratio 1 : 2. Equilibrium constants for zirconium with iminodiacetic, nitrilotriacetic, and ethylenediaminetetraacetic acids are 0.35×10^{-3}, 2.63×10^{-7}, and 1.24×10^{-6}, respectively. (R.V.J.)

41460 MULTINUCLEAR CITRIC ACID COMPLEXES OF RARE EARTHS. V. I. Mishchenko and N. S. Poluektov (Inst. of General and Inorganic Chemistry, Odessa). Zh. Neorgan. Khim., 9: 1822-9(Aug. 1964). (In Russian)

Preparation and structure of multinuclear rare earth citric acid complexes were studied. Spectrophotometric analysis was made of reactions of Pr, Nd, Sm, La, and Y in citrate solutions at pH 9. The molar ratios and isomolar series indicated the formation of trinuclear complexes; moreover, in mixed complexes the elements with smaller ion radii attached themselves to the elements with larger ion radii in the ratio 1 : 2. The formation of mixed trinuclear complexes increased in dilute solutions. (R.V.J.)

41461 NEODYMIUM CHLORIDE COMPLEXES. T. V. Mal'kova, G. A. Shutova, and K. B. Yatsimirskii (Ivanov Inst. of Chemistry and Tech., Academy of Sciences, USSR). Zh. Neorgan. Khim., 9: 1833-7(Aug. 1964). (In Russian)

A new differential spectrophotometric method was used in the analysis of neodymium complexes with chloride ion in acid media. The thermodynamic stability constant of the complex $NdCl^{2+}$ is equal to 2.39×10^{-3}. (R.V.J.)

41462 BINARY OXIDES IN THE β-$Nb_2O_5-WO_3$ SYSTEMS. L. M. Kovba, V. K. Trunov, and Yu. P. Simanov. Zh. Neorgan. Khim., 9: 1930-3(Aug. 1964). (In Russian)

X-ray phase analysis of the β-$Nb_2O_5-WO_3$ system showed that the WO_3 solubility in β-Nb_2O_5 is comparably low and does not exceed 5 to 10%. Preparation of $WO_3 \cdot 2Nb_2O_5$, $WO_3 \cdot 4Nb_2O_5$, and $7WO_3 \cdot 4Nb_2O_5$ is described and compounds with high WO_3 content expressed by the formula $Nb_2O_5 \cdot nWO_3$ were found. (R.V.J.)

41463 THE $UO_2-Na_2CO_3-CO_2-H_2O-(SiO_2)$ SYSTEM AT HIGH TEMPERATURES AND HIGH PRESSURES. A. D. Vlasov. Zh. Neorgan. Khim., 9: 1980-7(Aug. 1964). (In Russian)

An analysis was made of U content in a solution as a function of the concentration of sodium carbonate, carbon dioxide (at 200°C), and temperature. The content of U increases linearly with the increase of sodium carbonate. An increase of carbon dioxide also increased the uranium concentration in the solution. However, at molarity of $m_{CO_2} > 0.45$, their concentrations remain at the same level. A small rise and drop in uranium concentration correspond to the rise and drop of the partial pressure in carbon dioxide. The amount of UO_2 precipitation affects its content in the solution. The concentration of uranium in a solution increases in direct proportion to the square root of the amount of uranium dioxide precipitate (200°C). The analysis indicated an adsorption of the air oxygen on the uranium dioxide crystals (at 20°C) and formation of sodium uranyldicarbonate at 200°C. (R.V.J.)

41464 THORIUM DISULFITE. V. A. Golovnya, A. K. Molodkin, and V. N. Tverdochlebov. Zh. Neorgan. Khim., 9: 2032-4(Aug. 1964). (In Russian)

Preparation of thorium disulfite by reaction of alkali metal sulfites and ammonia with thorium nitrate solution, by reaction of sulfuric gas with cold dilute thorium salt solution (nitrate, chloride, or sulfate), and by reaction of sulfuric gas with a hot dilute thorium nitrate solution is described. A table is given of the chemical analysis and relative densities of the thorium disulfites prepared. Thorium disulfite prepared from a cold solution is a white powder soluble in sulfite or ammonium carbonate solutions. The density of partially hydrolyzed thorium disulfite $Th(SO_3)_{1.5}(OH) \cdot 5.5H_2O$ is 3.15 g/cm³. The properties of thorium disulfite prepared with the hot solution differ from the cold solution thorium sulfite. The hot-prepared thorium sulfite is also dissolved by the same reagents as cold disulfite, but the reaction is much slower. In strong nitric or hydrochloric acid the latter dissolves without releasing sulfuric gas. The relative density is 3.85 g/cm³. The thermograms and the mass losses of the hot and cold thorium disulfite are tabulated. (R.V.J.)

41465 THE $KF-BeF_2$ SYSTEM. A. V. Novoselova, Yu. M. Korenev, and M. P. Borzenkova. Zh. Neorgan. Khim., 9: 2042(Aug. 1964). (In Russian)

A melt diagram constructed for the $KF-BeF_2$ system (50 to 100 mole % BeF_2) showed that starting with 70 mole % BeF_2, the system hardened as a vitreous material. The thermal analysis indicated that KBe_2F_5 melts congruently at 353°, forming a eutectic with $KBeF_3$ on one side and BeF_2 on the other. The eutectic point between $KBeF_3$ and KBe_2F_5 is found at 58 mole % BeF_2 and 327° and between the KBe_2F_3 and BeF_2 at 72 mole % BeF_2 and 346°C. (R.V.J.)

41466 PROTON MAGNETIC RESONANCE IN HYDRATED URANIUM TETRAFLUORIDE CRYSTALS. Yu. V. Gagarinskii, S. P. Gabuda, and G. M. Mikhailov (Inst. of Inorganic Chemistry, Novosibirsk, USSR and Inst. of Physics, Krasnoyarsk, USSR). Zh. Strukt. Khim., 5: 383-6(May 1964). (In Russian)

Studies were made of proton magnetic resonance spectra of hydrated uranium tetrafluoride crystals at 90 to 290°K. Two O–H bond configurations were observed in the cubic syngony. A longer bond was found in rhombic crystals. In addition, water molecules not connected to the H–F bond were observed in the rhombic crystals. (tr-auth)

41467 RADIOGRAPHIC STUDIES OF GADOLINIUM PHOSPHATES. V. G. Kuznetsov, S. M. Petushkova, and I. V. Tananaev (Kurmakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Strukt. Khim., 5: 397-403(May 1964). (In Russian)

A powder method was used in studies of solid phases separated from $GdCl_3-H_3PO_4-H_2O$ and $GdCl_3-Na_3PO_4-H_2O$ at 25°C, and x-ray data were developed for $9\,GdPO_4 \cdot Gd(OH)_3 \cdot 27\,H_2O$, $GdPO_4 \cdot H_2O$, $4\,GdPO_4 \cdot NaPO_4 \cdot 12\,H_2O$, and the products of thermal phase transformation ($GdPO_4$, $GdPO_4 \cdot 0.33\,H_2O$, $18\,GdPO_4 \cdot Gd_2O_3$, and $4\,GdPO \cdot Na_3PO_4$). The $GdPO_4$ exhibited two crystalline modifications: hexagonal (a = 6.89, c = 6.33 Å, space group $D_6^6 = P6_422$) and isostructural, with hexagonal modifications for La, Ce, and Nd phosphates and, probably, monoclinic monazite isostructure. (tr-auth)

41468 THE INTERACTION OF THREE METAL IONS WITH THE SURFACE OF SILICA GEL. Jimmy Howard Stanton. Thesis, University, Miss., Univ. of Mississippi, 1963. 77p.

A study of the reaction of the metal ions, uranyl, thorium, and aluminum, with the hydrogen of the surface silanol groups of silica gel was made. By determining the equilibrium constants for the reactions the values of the thermodynamic functions were calculated. These values were: $\Delta F^0_{298} = 7.02$ kcal/mole, $\Delta H^0 = 3.95$ kcal/mole, $\Delta S^0_{298} = -11.5$ e.u.; thorium $\Delta F^0_{298} = 8.29$ kcal/mole, $\Delta H^0 = 11.0$ kcal/mole, $\Delta S^0_{298} = 9.09$ e.u.; aluminum, if it is assumed that 3 hydrogen ions are produced, gives $\Delta F^0_{298} = 11.47$ kcal/mole, $\Delta H^0 = 21.62$ kcal/mole, $\Delta S^0_{298} = 34.06$ e.u., or if only 2 hydrogen ions are produced, $\Delta F^0_{298} = 8.35$ kcal/mole, $\Delta H^0 = 17.82$ kcal/mole, $\Delta S^0_{298} = 31.77$ e.u. From these values it was possible to postulate an ion-surface complex for the reacted ion. In all cases there seemed to be a strong ordering of the system upon reaction of the ion with the gel surface. Exclusion studies were made on thorium solutions to determine the competitive action of thorium ions for water. The competition between hydrogen and thorium ions for water was also studied. It was shown that the hydrogen ion was able to compete with the thorium ion for the water. The effect of the nitrate ion upon the thorium species in solution was also investigated. At high acid concentrations an addition of nitrate ions was accompanied by an increase in the size of the thorium species. (Dissertation Abstr., 25: No. 1, 1964)

41469 RELAXATION STUDIES OF ADSORPTION ON THORIUM OXIDE. Kenneth Dare Lawson. Thesis, Gainesville, Fla., Univ. of Florida, 1963. 176p.

The behavior of polar molecules adsorbed on thoria and alumina was studied by magnetic resonance techniques using a Varian spectrometer and by dielectric techniques using an impedance bridge circuit. Nuclear resonance studies of water on thorium oxides indicate differences in the surfaces of oxides prepared by two methods. Significant differences are found between the oxides prepared by the thermal decomposition of thorium oxalate and those prepared by precipitation of thorium hydroxide. Temperature dependence studies of the n.m.r. line widths suggest that water molecules on the precipitated oxides possess only one general type of motion while water on the oxalate oxides appears to have two kinds of motional freedom, differing significantly in the magnitudes of the activation energies. Studies of adsorbed methanol, ethanol, and butylamine by n.m.r. show that these molecules interact to different degrees with the oxide surfaces. The specific interactions appear to be related to the pore structure of the oxides. Temperature studies of the line widths and relaxation times of the adsorbed alcohols and butylamine show that different kinds of protons in these molecules lose motional freedom at different temperatures. This is taken as an indication that specific interactions between the various groups in the molecules and the adsorbing surface are present. Both n.m.r. and dielectric results indicate that ordering persists in adsorbed materials for several molecular layers and that adsorbed materials exist in a state somewhere between a liquid and a solid. (Dissertation Abstr., 25: No. 1, 1964)

41470 THEORETICAL CALCULATIONS OF CHEMICAL SHIFTS IN NMR: APPLICATION TO THE XENON FLUO-

RIDES. Cynthia Santos Juan. Thesis, Urbana, Ill., Univ. of Illinois, 1963. 74p.

The general trend of the range of chemical shifts (the difference between the chemical shifts of the lowest field and highest field signals for a particular nuclear species) is to increase with atomic number Z for elements of the same group in the periodic table, and for elements of different groups, to increase with Z along a period. This somewhat periodic trend is explained in terms of the paramagnetic contribution to the chemical shift and its dependence on $\langle 1/r^3 \rangle$. Explicit expressions for the paramagnetic contribution to the chemical shielding, $\sigma^{(2)}$, are given in the valence bond and LCAO-MO framework, including d as well as p orbitals on the atom in question. Valence bond and LCAO-MO wavefunctions are given for the xenon fluorides, XeF_2, $XeOF_4$, XeF_6, and XeO_2F_4, according to the localized description and xenon orbital hybridization proposed by L. C. Allen. Delocalized M.O.'s for XeF_2 and XeF_4 according to the description proposed by R. E. Rundle others are also given. These wavefunctions, as well as the ones given in the literature by Waters and Gray, and Jortner, Wilson and Rice, were used to calculate the xenon chemical shifts (anisotropy and average over-all orientations) in terms of the Xe–F bond ionicity. Qualitative and quantitative comparisons with experimental chemical shifts are given, and the xenon chemical shift of XeF_6 is predicted. The results indicate that the change in the paramagnetic contribution is the dominant term in the xenon chemical shift and that the localized descriptions using s and d hybridization give better agreement with experiment than the delocalized m.o. descriptions utilizing only p orbitals on the xenon. Fluorine chemical shifts in the xenon fluorides are also discussed. (Dissertation Abstr., 25: No. 1, 1964)

41471 CONDUCTANCES, VISCOSITIES, AND THE SPECTRA OF SOME RARE EARTH AND CADMIUM SALTS IN NON-AQUEOUS SOLVENTS. David Owen Johnston. Thesis, University, Miss., Univ. of Mississippi, 1963. 262p.

The viscosities, conductances, and spectra of hydrated rare earth chlorides and nitrates (except Pm) dissolved in methanol were measured over a concentration range of 0.0004 to 0.4$\underline{M}$. The viscosities and conductances were measured at 5, 20, and 45°C; the spectra were recorded at room temperature. The viscosities and conductances at 5, 20, and 45°, and the spectra at 20 and 45°, were measured for $CdCl_2$, $CdBr_2 \cdot 4H_2O$, CdI_2, $Cd(NO_3)_2 \cdot 4H_2O$, and $Cd(C_2H_3O_2)_2 \cdot 2H_2O$ dissolved in methanol. Also studied were the conductances, viscosities, and spectra of the $CeCl_3 \cdot 7H_2O$–methanol–carbon tetrachloride system, the conductances and spectra of the $CeCl_3 \cdot 7H_2O$–1–propanol, -2-propanol, and -isobutyl alcohol systems, and the conductances of the $CdCl_2$-water-methanol system. Computer methods, with error analysis techniques, were used to test the compatibility of the data with seven two-dimensional conductance equations, fifteen viscosity equations, and two spectral equations. (A.G.W.)

41472 A CONDUCTANCE STUDY OF SALTS OF THE GROUP IIA METALS IN NON-AQUEOUS AND IN MIXED SOLVENTS. William Robert Carper. Thesis, University, Miss., Univ. of Mississippi, 1963. 71p.

The conductances of $BaCl_2 \cdot 2H_2O$, $Be(NO_3)_2 \cdot 3H_2O$, $BeSO_4 \cdot 4H_2O$, $Ca(NO_3)_2 \cdot 4H_2O$, $Ca(ClO_4)_2 \cdot 6H_2O$, $Mg(C_2H_3O_2)_2 \cdot 4H_2O$, $MgCl_2 \cdot 6H_2O$, $Mg(NO_3)_2 \cdot 6H_2O$, $Mg(ClO_4)_2 \cdot 6H_2O$, $MgSO_4 \cdot 7H_2O$, $SrCl_2 \cdot 6H_2O$, $Sr(ClO_4)_2$ and $Sr(ClO_4)_2 \cdot 6H_2O$ dissolved separately in methanol, and $Ca(ClO_4)_2 \cdot 6H_2O$, $Sr(ClO_4)_2 \cdot 6H_2O$, $Be(NO_3)_2 \cdot 3H_2O$, $Mg(ClO_4)_2 \cdot 6H_2O$ and $Mg(NO_3)_2 \cdot 6H_2O$ dissolved separately in n-propanol, isopropanol, n-butanol, isobutanol, n-amyl alcohol and isoamyl alcohol were measured at 20° and 45°C. A precision bridge was used to measure the conductances of $Ca(NO_3)_2 \cdot 4H_2O$, $Be(NO_3)_2 \cdot 3H_2O$ dissolved separately in methanol and $Be(NO_3)_2 \cdot 3H_2O$ in methanol-carbon tetrachloride at 20°C. Specific conductance versus concentration plots consisted of either two or three linear segments. R values (molar conductance at 45°C/molar conductance at 20°C) were either independent or linear with concentration except for $Mg(C_2H_3O_2)_2 \cdot 4H_2O$. Intersection points (between upper two linear segments) taken from specific conductance versus concentration plots were linear with the dielectric constant of the solvent or solvent combination. Equivalent conductances were best described by series expansion equations. (Dissertation Abstr., 25: No. 1, 1964)

41473 OXIDATION STATES OF RADIOGENIC LEADS IN URANIUM MINERALS. Lawrence Robbins Hathaway. Thesis, Lawrence, Kan., Univ. of Kansas, 1963. 84p.

Experiments designed to demonstrate the presence or absence of tetravalent radiogenic lead in uranium minerals were carried out using a number of carnotite, pitchblende, and other uranium-bearing samples. The separation of the divalent lead phase from a tetravalent lead phase depends upon the use of a dissolution medium in which only the divalent lead phase is soluble and no exchange can occur between the di- and tetravalent lead phases. Studies of the distributions of the ^{210}Pb, ^{206}Pb, and ^{207}Pb isotopes between the soluble mineral phase and the insoluble matrix phase, coupled with a study of the distribution of ^{226}Ra between the two mineral phases, indicate that no tetravalent lead is produced as a result of radioactive decay in uranium minerals. The ^{210}Pb found in the insoluble mineral matrix, as well as the ^{210}Pb in the soluble mineral phase, appears to be in radiochemical equilibrium with the ^{226}Ra in the respective phase in most cases. However, a disequilibrium exists between the ^{238}U parent and ^{226}Ra in the insoluble mineral matrix since no uranium is found in the insoluble mineral matrix phase. In at least one case there is strong evidence that uranium has been added to a mineral recently in its geologic history. (Dissertation Abstr., 25: No. 1, 1964)

41474 THE VAPORIZATION AND THERMODYNAMICS OF THORIUM DICARBIDE. Richard Allen Kent. Thesis, East Lansing, Mich., Michigan State Univ., 1963. 192p.

Thorium dicarbide of high purity was prepared by the reaction of graphite either with thorium metal or thorium dioxide and the subsequent homogenization of the crude product by heating at approximately 2400°K in a graphite crucible in high vacuum. The vaporization of thorium dicarbide over the temperature range 2100 to 2500°K was investigated by the Knudsen effusion method. Chemical and x-ray diffraction analyses of both starting materials and residues were performed. The rate of effusion of thorium-containing species measured in the target experiments was expressed in terms of an "effective vapor pressure" P_E, which, when combined with the molecular weight of 256.06, gave directly the rate of evaporation of thorium dicarbide. The observed volatility varied by a factor of 10^3 over the 400-degree temperature range and at 2360°K was about 0.025 per cent that of thorium dioxide and about 0.006 per cent that of thorium metal. Combination of the published mass spectrometric data for the vaporization of thorium dicarbide and the target data measured in this investigation, yielded the data requisite to a linear treatment of the individual vapor species as a function of reciprocal temperature. By means of the second law of thermodynamics the following values were obtained: for the reaction $ThC_{2(s)}$ = $Th_{(g)}$ + $2C_{(graphite)}$(I), ΔH^0_{298} = 176.92 ± 3.30 kcal/mole, and ΔS^0_{298} = 34.49 ± 0.64 e.u.; for the reaction $ThC_{2(s)}$ = $ThC_{2(g)}$ (II), ΔH^0_{298} = 196.24 ± 3.30 kcal/mole, and ΔS^0_{298} = 42.81 ± 0.72 e.u. Values were estimated for the free energy functions of $ThC_{2(s)}$ and $ThC_{2(g)}$ and these were combined with the published data for graphite and $Th_{(g)}$ to yield the following values calculated from the third law of thermodynamics: for the reaction (I), ΔH^0_{298} = 175.82 ± 0.68 kcal/mole; for the reaction (II), ΔH^0_{298} = 204.96 ± 1.25 kcal/mole. The enthalpies obtained for the dissociation reaction (I) were combined with the published value for the enthalpy of vaporization of thorium metal and the following values for the standard enthalpy of formation of $ThC_{2(s)}$ were calculated: from the second law, ΔH^0_{298} = −40.32 ± 3.33 kcal/mole; from the third law, ΔH^0_{298} = −39.22 ± 0.84 kcal/mole. (Dissertation Abstr., 25: No. 1, 1964)

41475 THE KINETICS OF THE REACTION OF HYDROGEN WITH CERIUM METAL AT ROOM TEMPERATURE. William Glen Bos. Thesis, Detroit, Wayne State Univ., 1963. 188p.

The literature concerning hydrides of the rare earth metals is reviewed. A general discussion of the kinetics of gas-solid reactions is given. The present investigation was carried out using high purity cerium metal and hydrogen prepared by the thermal decomposition of uranium hydride. Experiments were performed in an all-glass apparatus, which could be evacuated to less than 1×10^{-5} mm of Hg. The reaction of a block of cerium metal with hydrogen in a constant-volume apparatus exhibited the following stages: an induction period, an autoacceleration stage, and a period of declining reaction rate culminating when the sample became saturated with hydrogen. The reaction of hydrogen with the thermally decomposed product of this reaction was extremely rapid. The absorption of hydrogen by a powdered sample of CeH_2 was very rapid in its early stages, but relatively slow as it neared completion. The decline in the reaction rate observed in a constant-volume apparatus could not be attributed to the decrease in pressure alone. The reaction of hydrogen with thin slabs of cerium metal was preceded by an induction period. Following this, the reaction rate increased regularly to a maximum value, then decreased slightly. A second increase in the reaction rate led to the establishment of a constant rate that persisted through approximately half of the absorption process. As the reaction neared completion, the rate declined, reaching a value of zero when the sample had become saturated. Samples of cerium metal annealed in vacuo at 400°C for several hours reacted with hydrogen four times as rapidly as unannealed samples. The reaction was retarded by the presence of 0.01% of air in the reacting hydrogen. The reaction rate was found to vary from sample to sample in spite of efforts to reproduce experimental conditions. In order to determine the pressure dependence of the reaction rate, each of five metal samples was reacted with hydrogen at three or more pressures. Possible mechanisms for the reaction are discussed. The role of oxide surface films in determining the reaction rate is emphasized. (Dissertation Abstr., 25: No. 1, 1964)

41476 THE 2000 A ABSORPTION SYSTEM OF NH_3, ND_3, AND NT_3. Bernard Theodore Young. Thesis, College Station, Tex., Agricultural and Mechanical Univ., 1964. 98p.

The absorption spectra in the 2000 Å region of NH_3 and ND_3 taken by B. L. Landrum and of NT_3 taken by J. R. Henderson are examined, with emphasis on the temperature-sensitive bands. Three new ND_3 and four new NT_3 bands are observed. One NH_3, three ND_3, and three NT_3 assignments are changed. New assignments are made for two ND_3 bands and two NT_3 bands. In the composite of Landrum's, Henderson's, and this work, the number of temperature-sensitive bands identified is eight for NH_3, nineteen for ND_3, and eighteen for NT_3. Of the ND_3 bands, twelve correspond to transitions from ground state levels which involve ν_1'' or $2\nu_1''$ in combination with the inversion levels. There are six levels of ND_3 known from infrared spectra which may be calculated from the present data. The average disagreement is about 2 cm^{-1}. In addition nine ground state vibrational levels were determined, which were not previously known. Except that less bands are observed for NH_3 and NT_3, results are similar to those of ND_3. Both NH_3 and ND_3 absorption intensities for the $(0000) \leftarrow (0\ v_2''\ 00)$ transitions, where $v_2'' = 0^+, 1^+, 2^+$, and 3^+, are experimentally measured, and the corresponding relative intensities are calculated using the Franck-Condon Principle. The average disagreement is 17%. The excited state fundamental frequencies ν_1' and ν_3' for ND_3 and ν_1', ν_3', and ν_4' for NH_3 and NT_3 are theoretically determined using the experimental NH_3–ND_3 isotope shift and the faint bands in ND_3 tentatively assigned to $2\ \nu_4'$. (Dissertation Abstr., 25: No. 1, 1964)

41477 ADVANCES IN STRUCTURE RESEARCH BY DIFFRACTION METHODS. VOLUME 1. R. Brill, ed. New York, Interscience Publishers, 1964. 227p. $13.50.

Information is included on: determination of crystal structures by neutron diffraction measurements; Fourier synthesis of potential in electron diffraction structure analysis and its applications to the study of hydrogen atoms; determination of phase angles; antisymmetry, color symmetry, and degenerate symmetry; thermal background scattering and its use in structural investigations of molecules in crystals; and interpretation of diffuse interference of defect-ordered crystals. (P.C.H.)

41478 METALLIC COATINGS. (to United Kingdom Atomic Energy Authority). French Patent 1,212,052. Oct. 19, 1959. Priority date Mar. 22, 1957, Great Britain.

A method and apparatus for powder metallurgically coating an article, e.g., for the manufacture of fuel elements, are described. A coating of compacted metal powder is applied to the article which is inserted in a close-fitting casing. This assembly is heated in a gas-pressure furnace to such a temperature that the casing softens and the powder is pressure sintered. The article can consist of UO_2, the coating metal of Be, and the casing of soft steel. For these the furnace temperature is 1050 to 1150°C and the pressure 105 to 170 kg/cm^2. The casing is removed by dissolution in nitric acid. A detailed description of the continuously operating furnace is given. (NPO)

41479 NEW DENSE CONSTRUCTION MATERIAL, RICH IN IRON. (to G. and W. H. Corson, Inc.). French Patent 1,221,443. Jan. 11, 1960. Priority date Mar. 27, 1958, United States.

A filler material was developed for cement compositions, which can be used for the construction of concrete shields. It consists of spherical, vitreous aluminum silicate particles in which ferromagnetic spinel crystallites are dispersed. The density of the particles is 3.8 to 4.8 g/cm^3 their composition 70 to 95% Fe_2O_3, 3 to 12% SiO_2, and 1 to 6% Al_2O_3, and their particle size less than 100 mesh. The filler material can be obtained from fly ashes. (NPO)

41480 HIGH PRESSURE FURNACE. (to Societe des Chantiers Reunis Loire-Normandie). French Patent 1,249,280. Nov. 21, 1960. Filed Nov. 7, 1959.

A horizontal, electrically heated furnace was developed, which can be utilized for metal canning of uranium bars under gas pressure. (NPO)

41481 METHOD OF APPLYING A STEEL OR IRON COATING, NOTABLY ON JACKETS OF NUCLEAR FUEL ELEMENTS AND FUEL ELEMENTS COMPRISING SUCH A COATING. (to Deutsche Gold- und Silber-Scheideanstalt). French Patent 1,251,523. Dec. 12, 1960. Priority date Feb. 14, 1959, Germany.

Two methods for applying a steel coating to Zr or Al jacketed fuel elements are described. In the first method a solder layer is applied on the fuel element by vacuum metallization; the fuel element is inserted in a steel casing and the assembly subjected to heat and pressure in an autoclave in order to bond the casing to the jacket. In the second method a solder coated steel strip is wrapped around the fuel element, which is treated in an autoclave. (NPO)

41482 IMPROVEMENTS IN METHODS OF ELECTROLYTIC NICKEL PLATING. (to Commissariat a l'Energie Atomique). French Patent 1,260,085. Mar. 27, 1961. Filed Mar. 22, 1960.

A method for the application of electrolytic, B- and C-free Ni coatings without discontinuities to U bars is described. The composition of a typical plating bath and the working conditions are: $NiSO_4 \cdot 7H_2O$, 280 g/l; $NiCl_2 \cdot 6H_2O$, 35 g/l; $K_2Al_2(SO_4)_4 \cdot 24H_2O$, 70 g/l; 40 to 60°C, pH 3 to 5; and current density 2 to 5 amp/dm^2. (NPO)

41483 METHOD OF RENDERING GRAPHITE COMPACT. (to Deutsche Gold- und Silber-Scheideanstalt). French Patent 1,287,587. Feb. 5, 1962. Priority date Feb. 20, 1960, Germany.

The density of nuclear graphite was increased by impregnating it under pressure with a suspension of acetylene black in a liquid carrier (benzene, naphthalene, anthracene, pyrene, phenol, or pitch) followed by evaporation of the carrier. The method can be applied for impermeabilization of graphite fuel spheres. (NPO)

41484 METHOD OF OBTAINING CARBON DEPOSITS. (to PECHINEY, Compagnie de Produits Chimiques et Electrométallurgiques). French Patent 1,290,243. Mar. 5, 1962. Filed Feb. 28, 1961.

Dense carbon deposits having a purity of over 99.9% were obtained by vaporizing carbon with a purity of 90 to 99% at 2500 to 3000°C in argon or hydrogen at less than 0.1 mm pressure and condensing the carbon vapor on a support having a temperature of 1500 to 3000°C. The vaporization was effected either in an electric arc or by electron bombardment. Such deposits can be applied in nuclear technology, e.g., as fuel element jackets, as solid bodies, or as coatings for high temperature fuel element jackets. (NPO)

41485 METHODS OF PREPARING URANIUM CARBIDES BY CHEMICAL REACTION. (to Nuclear Materials and Equipment Corp.). French Patent 1,290,403. Mar. 5, 1962. Priority date Apr. 4, 1960, United States.

Uranium carbides were prepared by the reaction between UO_2 or U_3O_8 and a stoichiometric quantity of C in an electric arc. The consumable electrode was made from the oxide-carbon mixture and the current density was 62 to 108 amp/cm^2. Apparatus consisted of an evaucatable, closed container, the bottom of which was formed by the cooled cup-shaped collector electrode, in which the consumable electrode was axially hung. (NPO)

41486 METHOD OF PREPARING URANIUM OXIDE UO_2 FOR FUEL PELLETS. (to U. S. Atomic Energy Commission). French Patent 1,295,817. May 2, 1962. Priority date Sept. 30, 1960, United States.

A method is described for the preparation of UO_2 that can be compacted to coherent bodies at low pressures without the use of a binder and that sinters rapidly and uniformly at high temperature, giving sintered bodies that need no rectification. The method consists of the following steps: precipitation of ammonium uranate from a UO_2F_2 solution having 16% of the saturation concentration with such a quantity of NH_4OH that the NH_4 : U ratio is at least 25 : 1; conversion of the precipitate with steam at 400 to 650°C to U_3O_8; reduction of the U_3O_8 to UO_2 with H_2 at 550 to 600°C; reoxidation of the UO_2 with cold air to a O : U ratio = 2.08 to 2.12. To produce sintered bodies the final powder was precompacted at 1055 kg/cm^2, ground, and again compacted at 350 to 600 kg/cm^2; the compacts were sintered in H_2 at 1800°C. (NPO)

41487 URANIUM–MOLYBDENUM ALLOY AND ITS METHOD OF PREPARATION. (to Commissariat a l'Energie Atomique). French Patent 1,303,032. July 30, 1962. Filed July 21, 1961.

U–Mo fuel alloys with a Mo content of 0.3 to 0.6 wt % were prepared by vacuum melting the two metals in a graphite crucible, covered with an aluminum oxide or calcium zirconate brasque, casting the alloy to obtain bars or tubes, heating the ingots at 675 to 800°C, suddenly quenching them to 550°C in a fused salt bath, and finally cooling them at a velocity of 20 to 60°C/min. These alloys have a microstructure without preferential orientation and the grain size is 60 to 80 μ. This makes them superior to unalloyed U as to creep, traction, and thermal cycling resistance. (NPO)

41488 NEW URANIUM–MOLYBDENUM ALLOY AND ITS METHOD OF PREPARATION. (to Commissariat a l'Energie Atomique). French Patent 1,303,033. July 30, 1962. Filed July 21, 1961.

U–Mo fuel alloys with a Mo content of 1 to 3 wt % were prepared by vacuum melting the two metals in a graphite crucible, covered with a brasque of Al_2O_3 or Ca zirconate, casting the molten alloy to obtain bars or tubes, and cooling the ingots at a velocity of 10 to 80°C/min. The alloys are constituted by grains of 20 to 80 μ, without a preferential orientation. This makes them superior to unalloyed U as to creep, traction, and thermal cycling resistance. (NPO)

41489 METHOD FOR THE CONTINUOUS REGENERATION OF METALLIC HYDRIDES IN REACTORS. (to Interatom Internationale Atomreaktorbau G.m.b.H.). French Patent 1,308,382. Sept. 24, 1962. Priority date Dec. 31, 1960, Germany.

Metallic hydrides or deuterides, utilized as moderators or reflectors, are continuously regenerated during operation of the nuclear reactor by maintaining in the reactor a hydrogen pressure that is above the dissociation pressure. Thus with Zr, Ti, Nb, V, La, Ce, and Th hydrides or deuterides the hydrogen pressure is 1 to 10 mm Hg at a working temperature of 300 to 700°C; with U and Pu hydrides or deuterides the hydrogen pressure is 10 to 100 mm Hg at 200 to 450°C. (NPO)

41490 IMPROVEMENTS IN METHODS OF ELECTROLYTIC DEPOSITION ON METALS, PARTICULARLY URANIUM BARS FOR NUCLEAR FUEL ELEMENTS. (to Communaute Europeenne de l'Energie Atomique (EURATOM)). French Patent 1,309,580. Oct. 8, 1962. Priority date Jan. 14, 1961, Italy.

U bars were electrolytically pickled in 10% nitric or sulfuric acid at 6 v tension. The pickled bars were electroplated in a bath containing Ni_2SO_4, 200 g/l; sodium citrate, 40 g/l; NH_4Cl, 5 g/l; and Lissapol, 2 ml. The working conditions are pH 4.5, temperature 25°C, and current density 1.5 a/dm^2. Compact, adherent, tough Ni coatings of uniform thickness and free from B were obtained. (NPO)

41491 IMPROVEMENTS IN APPARATUS FOR ELECTROLYTICALLY PICKLING AND PLATING METALS, PARTICULARLY URANIUM BARS FOR NUCLEAR FUEL ELEMENTS. (to Communaute Europeenne de l'Energie Atomique (EURATOM)). French Patent 1,309,581. Oct, 8, 1962. Priority date Jan. 14, 1961, Italy.

An apparatus for use in electrolytic pickling and plating of metals is described. The apparatus consists of a tub in which the bar to be treated is supported on two circular frames, which oscillate. The displacement of the bar is limited by a box-shaped electrode on the bottom of the tub. The other electrode is mounted in the axis of the frames and consists of two semi-cylinders of perforated metal sheet. One of the semi-cylinders is used for pickling, the other for electroplating. (NPO)

41492 CRYSTALLINE SPHERULES. (to Minnesota Mining and Mfg. Co.). French Patent 1,311,516. Oct. 29, 1962. Filed Dec. 11, 1961.

B_4C and $U_nTh_mC_2$ ($m + n = 1$) spherules, with a dia = 50 to 200 microns, were prepared by mixing pulverized carbide of appropriate grain size with 5 to 20 times the weight of carbon powder of smaller grain size and rapidly heating the mixture in an inert atmosphere (He or Ar) above the melting point of the carbide (2300 to 2700°C) for some minutes, rapidly cooling to beneath the melting point, and mechanically separating the crystalline spherules from the carbon, possibly with the aid of surface active agents or ultrasonics. The spherules can be used in preparing dispersion fuels or control materials. (NPO)

41493 NEW ALUMINIUM–PLUTONIUM ALLOYS AND METHOD OF PREPARATION. (to Atomic Energy of Canada Ltd.). French Patent 1,319,838. Jan. 21, 1963. Priority date, Apr. 19, 1961, United States.

Ternary Pu–Al fuel alloys are described, which are corrosion resistant towards high-temperature water. They consist of 2 to 8 wt % Pu, either 1 to 2 wt % Ni or 13 to 17% U or Si, and the balance Al. Preferred compositions are 5 wt % Pu and 1 wt % Ni or 15 wt % U or Si. The alloys are prepared by reducing PuO_2 with an excess of Al at 1100 to 1200°C in the presence of Na_3AlF_6 and adding to the molten Pu–Al alloy the necessary quantity of Ni at 765 to 785°C, Si at 840 to 860°C, or U at 940 to 960°C. (NPO)

41494 IMPROVEMENTS IN PRODUCTS COATED WITH REFRACTORY MATERIAL AND APPARATUS FOR THEIR PREPARATION. (to U. S. Atomic Energy Commission). French Patent 1,335,189. July 8, 1963. Priority date Aug. 8, 1961, United States.

The preparation of coated fuel particles is described. A vertical bed of the particles, e.g., UO_2, was fluidized by means of a H_2 stream, which contains a mixture of $AlCl_3$, $ZrCl_4$, or ICl_3 and CrO_2Cl_2 while steam is injected half way up the bed. The bed is maintained at 300 to 1400°C. Thus by hydrolysis and reduction refractory coatings are produced that have a Cr_2O_3 content not exceeding 5%. These coatings are considered less liable to fissuring. (NPO)

Organic Chemistry

41495 (BNL-8317) ON THE SEPARABILITY OF INDUCTIVE AND RESONANCE EFFECTS WITHIN THE FRAMEWORK OF LINEAR FREE ENERGY RELATIONSHIPS. S. Ehrenson (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 20p. (CONF-694-1)

From Symposium on Linear Free Energy Correlations, Durham, N. C., Oct. 1964.

A continuation of non-linear least-squares analysis of aromatic reactivity data is discussed. More general forms of the dual substituent linear free energy equation reveal Taft's assumption of proportional sensitivity of log k/k_0 to inductive and resonance effects is reasonable, at least for σ^0- and σ-type reactivities. However, various transformations among parameter sets are shown to hold, which imply I and R effects are not uniquely separable by statistics, without specification of the magnitude of the sensitivity proportionality constant. Relations of the latter to such questions as positional dependence of I and R effects are discussed. Models for the total I-effect, which include classical and π-inductive effects, are presented and analyzed relative to each other and in relation to accompanying resonance effects. (auth)

41496 (PAN-523/XVII) OTRZYMYWANIE I OCZYSZCZANIE BLEKITU LEUKOMETYLENOWEGO. (Obtaining and Purification of Leucomethylene Blue). Roman Broszkiewicz and Zofia Gorska-Bulhakowa (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1964. 7p.

A method of obtaining and purification of leucomethylene blue has been proposed. The leucobase has been produced in a neutral solution by reduction of methylene blue hydrochloride by sodium pyrosulfite. All manipulations connected with production and purification of the leucobase have been carried on in a glove box in the atmosphere of CO_2 deoxygenated on the copper column. (auth)

41497 PREPARATION OF CARBON-14- AND TRITIUM-LABELLED COMPOUNDS BY HYDROBORATION PROCEDURES. R. W. Numrich, Nguyen H. Nam, and R. F. Nystrom (Univ. of Illinois, Urbana). Chem. Ind. (London), No. 28, 1269(July 11, 1964).

A novel synthesis of multiply T-labelled compounds was achieved by combining the hydroboration-isomerization process with a catalytic exchange reaction. The hydroboration-isomerization-displacement method was also found useful in preparing ^{14}C-labelled intermediates. For example, a 1-olefin-1-^{14}C was converted to a 1-olefin-1, $\omega{}^{14}$C and a ring olefin-1-^{14}C to a ring olefin uniformly labelled with ^{14}C. Treatment of a sample of oct-1-ene-1-^{14}C with diborane in the presence of triglyme gave a mixture of organoboranes. Isomerization was then effected by heating with compounds containing boron-hydrogen bonds at 216°C for three hr. After cooling, dec-1-ene was added and the solution heated at 160-170°C. The oct-1-ene-^{14}C which resulted was obtained in a radiochemically pure form by distillation using a Piros-Glover spinning band column. Degradation and analysis showed that the 1-position in the oct-1-ene-^{14}C contained 49% of the ^{14}C. This is in agreement with the postulate that the ^{14}C distribution in the isomerized oct-1-ene-^{14}C should be 50% at carbon atom 1 and 50% at carbon atom 8 if the boron atom moves back and forth many times along the carbon chain during the isomerization reaction. This result also explains the T-labelling pattern previously found in isomerized hex-1-ene-^{3}H. Thus, the hydroboration-isomerization displacement process can be used to prepare fatty acids, labelled in the methyl group with ^{14}C, by oxidative degradation of the product formed by isomerizing a straight-chain 1-olefin-1-^{14}C. Another example, which is presented, is the application of this process to a ring olefin, cyclohexene-1-^{14}C. The isomerized product was cyclohexene uniformly labelled with ^{14}C. Oxidative degradation of this material gave adipic acid uniformly labelled with ^{14}C. By application of the catalytic exchange method, T-labelled cyclohexene was prepared. A mixture of dicyclohexylborane, triglyme, a trace of boron trifluoride etherate, and T gas was heated at 216°C for one hr. The excess T gas was then removed and the radioactive cyclohexene obtained by displacement with dec-1-ene at 160–170°C. A radiochemically pure sample of cyclohexene-^3H was degraded by isotopically reliable procedures and was found to be multiply, and almost uniformly, labelled with T. (BBB)

41498 SYNTHESIS OF [1-^{14}C] ERYTHRITOL AND [1-^{14}C] THREITOL. P. W. Kent and K. R. Wood (Oxford Univ.). J. Chem. Soc.: 2812-13(Aug. 1964).

The synthesis of [1-^{14}C] erythritol and [1-^{14}C] threitol was achieved by the addition of (^{14}C) cyanide to glyceraldehyde followed by reduction of the labeled tetronic esters. DL-glyceraldehyde (dimer) reacted readily with potassium (^{14}C) cyanide in potassium carbonate solution at room temperature to give mixed epimeric nitriles, which were hydrolyzed in situ to DL-(1-^{14}C)-erythronic and -threonic acids. After esterification methanolic hydrogen chloride, the products were reduced by potassium borohydride in boiling ethanol. Two crystalline products resulted, the major being DL-(1-^{14}C) erythritol in 33% yield by weight and 28% radioactive yield and the minor product DL-(1-^{14}C)-threitol. (P.C.H.)

41499 HIGH RESOLUTION INFRARED SPECTRA OF $C_2^{12}H_2$, $C^{12}C^{13}H_2$, AND $C_2^{13}H_2$. Walter J. Lafferty and Robert J. Thibault (National Bureau of Standards, Washington, D. C.). J. Mol. Spectry., 14: 79-96(Sept. 1964).

Two parallel bands in Fermi resonance, ν_3 and $\nu_2 + \nu_4^1 + \nu_5^1$, were studied in the 3200–3400 cm^{-1} region of $^{12}C_2H_2$. The calculated unperturbed frequencies for ν_3 and $\nu_2 + \nu_4^1 + \nu_5^1$ are 3288.66 cm^{-1} and 3288.11 cm^{-1}, respectively. The assignment of ν_3 to the higher frequency transition was confirmed by the study of this diad in $^{13}C^{12}CH_2$ and $^{13}C_2H_2$. In addition the absorption spectra of $^{13}C^{12}CH_2$ and $^{13}C_2H_2$ were obtained in the 2600–2800 cm^{-1}, 3300–3400, and 6400–6600 cm^{-1} spectral regions. The unperturbed vibrational frequencies were obtained for $^{13}C^{12}CH_2$, and a few of these frequencies were calculated for $^{13}C_2H_2$. Equilibrium B values were obtained for the isotopic carbon molecules, and these values were used to calculate accurate r_e distances for acetylene. The substitution structure was also calculated. (auth)

41500 RADIATION RESISTANT LUBRICATING OIL. (to The British Petroleum Co. Ltd.). French Patent 1,278,442. Oct. 30, 1961. Priority date Jan. 29, 1960, Great Britain.

A radiation-resistant lubricating oil was prepared by the reaction between a halogenated paraffin with 12 to 30 carbon atoms, containing 10 to 60 wt % halogen and at least the theoretical quantity of a lower aromatic hydrocarbon (e.g. benzene, toluene, or xylene) in the presence of a Friedel-Crafts catalyst. A radiation-resistant grease could be prepared from the oil by the addition of a conventional thickening agent, e.g. soap, clay, urea derivatives, etc. (NPO)

41501 METHOD OF LUBRICATING APPARATUS THAT IS EXPOSED TO IONIZING RADIATION. (to The British Petroleum Co. Ltd.). French Patent 1,278,443. Oct. 30, 1961. Priority date Jan. 29, 1960, Great Britain.

Apparatus exposed to ionizing radiation was lubricated with an oil prepared by removing the waxy paraffin constituents from a furfural extract and reducing the aromatics content of the refined extract by means of chromatography until the viscosity was 5 to 500 centistubes at 60°C. A radiation-resistant grease could be prepared from the oil by the addition of thickeners such as bentonite, silica, sodium terephthalamate, and urea derivatives. (NPO)

41502 RADIATION RESISTANT OIL AND LUBRICATING GREASE PREPARED FROM THIS OIL. (to The British Petroleum Co. Ltd.). French Patent 1,278,444. Oct. 30, 1961. Priority date Jan. 29, 1960, Great Britain.

A radiation-resistant oil was prepared by the reaction between 1 mol biphenyl or terphenyl and 1 to 5 mol olefin or alkyl halogenide with 1 to 20 carbon atoms in the presence of $AlCl_3$ and BF. The reagents were chosen so that the oil has a kinematic viscosity of 3 to 300 centistubes at 60°C. A non-soapy thickener can be added to the oil. (NPO)

41503 METHOD OF LUBRICATING APPARATUS EXPOSED TO IONIZING RADIATIONS. (to The British Petroleum Co. Ltd.). French Patent 1,278,445. Oct. 30, 1961. Priority date Jan. 29, 1960, Great Britain.

The method utilizes a lubricating oil with a viscosity of 5 to 500 centistubes at 60°C that is prepared by the reaction between toluenè and/or xylene and ethylene dichloride or dibromide in the presence of $AlCl_3$, BF_3, or $ZnCl_2$. A non-soapy thickener can be added to the oil. (NPO)

41504 LUBRICATING OIL HAVING A GREAT RESISTANCE TO IRRADIATION. (to The British Petroleum Co. Ltd.). French Patent 1,278,446. Oct. 30, 1961. Priority date Jan. 29, 1960, Great Britain.

A radiation-resistant lubricating oil was prepared by the reaction between 1 mol of a polyphenyl ether (e.g. phenoxybenzene, 1,4-diphenoxybenzene, or 4,4′-diphenoxyphenoxybenzene) and 1 to 3 mol of an olefin or an alkyl halogenide with 3 to 12 carbon atoms in the presence of $AlCl_3$, $ZnCl_2$, or BF_3. A radiation-resistant grease was prepared from the oil by the addition of a non-soapy thickening agent such as sodium texephthalamate, silica, clay, or urea derivatives. (NPO)

41505 METHOD OF PREPARING AROMATIC COMPOUNDS CONTAINING ISOTOPES. (to Ciba Soc. An.). French Patent 1,311,438. Oct. 29, 1962. Priority date Nov. 18, 1960, Switzerland.

Aromatic compounds were prepared by cyclization of acetylenic hydrocarbons containing deuterium, tritium, and/or $^{14}_{6}C$ by means of Ziegler catalysts. This benzene containing D instead of H can be prepared by cyclization of $DC \equiv CD$. Benzene containing $^{14}_{6}C$ can be prepared by cyclization of $H^{14}_{6}C \equiv {}^{14}_{6}CH$. The compounds can be applied as moderators and/or coolants for nuclear reactors. (NPO)

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Refer also to abstracts 41437, 41601, and 41897.

41506 (ML-TDR-64-169) BASIC STUDIES IN QUANTUM AND RADIATION CHEMISTRY. Marvin Vestal, M. Krause, and William H. Johnston (Johnston (William H.) Labs., Inc., Baltimore). May 1964. Contract AF33(616)-7678. 106p.

The primary interactions of high-energy photons and electrons with matter in the gas phase were studied. The experimental studies included measurements of the mass/charge spectra produced both by x-ray-ionization and by high-energy electron-ionization, as well as secondary electron energy measurements for both x ray and electron ionization. These measurements were carried out using a coincidence mass spectrometer. The molecules studied include propane, ethanol, ethylamine, silane, hydrogen sulfide, hydrogen chloride, argon, methane, ammonia, water, neon, ethyl silane, ethanethiol, ethyl chloride, methyl chloride, methyl bromide, ethyl bromide, hydrogen bromide, krypton, methyl iodide, ethyl iodide, carbon tetrachloride, xenon, mercury, dimethylamine, 1,3-butadiene, n-butane, 2-butyne, oxygen, and nitrogen. The data obtained in these investigations are the first comprehensive measurements of inner shell ionization by x rays in which the resulting mass/charge spectra were measured in a mass spectrometer. The theoretical interpretation and a semi-empirical correlation of the experimental data are discussed. (auth)

41507 (ORNL-3675) FABRICATION OF ^{137}Cs SOURCES. J. A. Jones (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 19p.

Sealed sources containing ^{137}CsCl suitable for medical, industrial, and research applications have been developed at Oak Ridge National Laboratory. The ^{137}Cs, separated from reactor fuel processing wastes, is prepared as ^{137}CsCl powder and pelleted under pressure into suitable shapes. The pellets are doubly encapsulated in stainless steel, sealed by fusion welding, and tested for leaks greater than 2×10^{-6} ml/sec. (auth)

41508 (ORNL-TM-782) PRODUCTION AND RECOVERY OF TIN-113, ANTIMONY-125 AND TELLURIUM-125m FROM REACTOR-IRRADIATED TIN. Howard T. Russell (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 8p.

Tin-113, antimony-125, and tellurium-125m were recovered from reactor-irradiated tin by a method using electroless deposition and precipitation. The radiochemical purity of each of the three nuclides was >99.99%, exclusive of any daughters. (auth)

41509 (TID-21044) PROGRESS REPORT [ON PHOTOCHEMISTRY OF NUCLEIC ACIDS]. Shih Yi Wang (Johns Hopkins Univ., Baltimore. School of Hygiene and Public Health). [1964]. Contract AT(30-1)-2798. 10p.

The photochemistry of nucleic acids and related compounds (thymine, 1,3-dimethylthymine, 5-bromo-1,3-dimethyluracil, 1,3-dimethyluracil, and thymidine) is summarized. The use of 1,3-dimethyluracil as a chemical actinometer is discussed. The potential energy of activated complexes and excited molecules is analyzed through reaction mechanism studies. (N.W.R.)

41510 (UJV-925/63) RADIAČNÍ SYNTHESY ORGANICKÝCH SLOUČENIN. PŘEHLEDNÝ REFERÁT. (Radiation Syntheses of Organic Compounds (Tabular Report)). Jaromír Kučera and Bohumír Chutný (Československá Akademie *Věd. Ústav Jaderného Výzkumu, Řež*). [1963]. 66p.

The report summarizes the literature on the radiation syntheses of organic compounds up to the end of 1962. Radiation synthetic reactions are classified according to type into groups, and these are radiation isomerization, oxidation, reactions in aqueous solutions, halogenation, sulfochlorination, reactions of inorganic chlorides, reactions of tetrachlormethane, reactions with nitrogen oxides, dimerization, addition to C = C bond, condensation, and other miscellaneous reactions. Individual types of radiation reactions are evaluated from the standpoint of eventual suitability as preparative reactions and furthermore are compared with analogous photoreactions and reactions initiated by chemical initiators. In summary it can be said that probably only chain reactions with radiation yields (G values) of the order of up to 10^3 and with chemical yields up to 90% will have preparative importance. Among these reactions belong particularly the addition to the C = C bond, chlorination, sulfochlorination, and oxidation. Of the remaining reactions the reactions of halogenides with hydrocarbons and also some special cases of isomerization and dimerization can have importance. (TTT)

41511 (ORNL-tr-224) EFFECT OF IONIZING RADIATION ON ORGANIC AND INORGANIC SYSTEMS. PART I. B. M. Mikhailov, L. V. Tarasova, and V. S. Bogdanov. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Tr. 1-go (Pervogo) Vses. Soveshch. po Radiats. Khim., Akad. Nauk SSSR, Otd. Khim. Nauk, Moscow, 1957, 218-22(Pub. 1958). 6p.

The effect of a 90 kev electron beam on methane, ethane, propane, and n-butane was studied. Dehydro-condensation was the basic radiolysis process of the aliphatic gaseous hydrocarbons. Liquid hydrocarbons constitute 50% of the methane transformation products and 70 to 90% of those of ethane, propane, and n-butane. (auth)

41512 (ORNL-tr-226) RADIATION-CHEMICAL TRANSFORMATIONS OF ORGANIC SUBSTANCES. SECTION II. FAST ELECTRON OXIDATION OF METHANE BY OXYGEN. B. M. Mikhailov, M. E. Kuimova, and V. S. Bogdanov. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Tr. 1-go (Pervogo) Vses. Soveshch. po Radiats. Khim., Akad. Nauk SSSR, Otd. Khim. Nauk, Moscow, 1957, 224-33(Pub. 1958). 11p.

Mixtures of methane and oxygen ($CH_4 : O_2 = 4 : 1$ and $1 : 1$) were subjected to fast electron radiation under static conditions. Among the reaction products formic acid, alcohols, and peroxides were found; about 50% of the oxidized methane passes into the liquid phase and the remaining into gas. No CH_2O was detected in the reaction products. An increase in the methane content in the mixture (from 50 to 80%) increased the oxidation rate of the process. A change in pressure (from 190 to 760 mm Hg) increased the reaction rate to an extent approximately proportional to the pressure. The formation of the liquid reaction products and H_2 occurred independently and proportionally to the time (dosage) of radiation. Apparently CO and CO_2 are the transformation products of formic acid. Hypotheses on the radiation oxidation of methane, based on radical non-chain schemes, were made. (auth)

41513 EFFECTS OF ION SCAVENGERS ON RADIATION-INDUCED POLYMERIZATION. W. R. Busler, E. Hubmann, and Ffrancon Williams (Univ. of Tennessee, Knoxville). Am. Chem. Soc., Div. Polymer Chem., Preprints, 5: 7p.(1964).

The ratio of rate constants for propagation to retardation was evaluated for radioinduced polymerization of cyclopentadiene from a combination of kinetic analysis and molecular weight studies. By invoking the assumption that the retardation reaction is a diffusion-controlled process, a value for the propagation rate constant could be derived, and this permitted determination of the lifetime of a propagating ion. The dependence of polymer yield on ammonia concentration, the effects of free-radical scavengers, dependence of polymer solubility on irradiation conditions, and kinetics of polymerization were determined. The radioinduced polymerization was strongly retarded by ammonia and the amines whereas typical free-radical scavengers were much less efficient. For a dose rate of 4.2×10^{15} ev ml^{-1} sec^{-1} the mean lifetime of a free ion was found to be 1.7×10^{-2} sec and the mean lifetime of a propagating ion was calculated to be 0.6×10^{-4} sec. Effects of ammonia as an ion scavenger in retarding radioinduced polymerization of α-methylstyrene were determined. It was also found that the rate of radioinduced polymerization of isobutyl vinyl ether is proportional to the 0.65 power of dose rate. (M.C.G.)

41514 RADIATION CHEMISTRY OF PROTEINS. II. ENZYMIC ACTIVITY AND DEUTERIUM EXCHANGE PROPERTIES OF LYSOZYME AND α-CHYMOTRYPSIN. C. O. Stevens, L. E. Henderson, and B. M. Tolbert (Univ. of Colorado, Boulder). Arch. Biochem. Biophys., 107: 367-73(Sept. 1964).

Chromatographically homogeneous egg-white lysozyme and crystalline α-chymotrypsin were irradiated in a ^{137}Cs source with γ rays, and the resulting samples were subjected to amino acid analyses, chromatographic examination, and deuterium exchange measurements. After a 10.7 Mrad dose one residue each of serine and tryptophan were lost per mole of α-chymotrypsin while in lysozyme, after a 26.6 Mrad dose, no significant loss in any amino acid residue was observed. From irradiated α-chymotrypsin only one discrete active component could be demonstrated chromatographically. Chromatographic examination of the phosphate soluble material in irradiated lysozyme revealed five active and one inactive components. In α-chymotrypsin hard-to-exchange-amide (peptide) hydrogens were lost at about the same rate as enzymic activity as a function of radiation dose. In lysozyme, irradiation disrupts conformation so that hard-to-exchange-amide (peptide) hydrogens were lost at least twice as rapidly as enzymic activity. These results indicate that enzymic activity in α-chymotrypsin is closely dependent on native molecular conformation whereas only about half the native conformation of lysozyme is essential to enzymic activity. (auth)

41515 SELECTION OF PARAMETERS FOR TWO-DIMENSIONAL RADIATION SOURCES. F. A. Makhlis. At. Energ. (USSR), 17: 147-9(Aug. 1964). (In Russian)

For the investigation, the surface of the source is subdivided into squares. The effect of the dimensions and number of squares, distance between them, and distribution of surface activity on the source efficiency are considered. Results of calculations are given for various thicknesses of irradiated object and for a plane 100 × 100 cm^2. (M.J.T.)

41516 RESPONSE OF POLAROID 3000x MEDICAL RADIOGRAPHIC PACKETS AFTER EXPOSURE TO CESIUM-137 GAMMA RAYS. Jacob Kastner (Argonne National Lab., Ill.), William G. Cibula, and Herbert J. Frede. Health Phys., 10: 665-6(Sept. 1964).

The relationship between reflection density and pre-exposure to ^{137}Cs radiation for Polaroid 3000x film was determined. Since it is necessary to determine shielding requirements in some cases to protect against nuclear bomb fall-out, cesium-137 radiation was used in the laboratory to simulate fogging effects from fall-out. Cesium was chosen because the gamma radiation from this isotope approximates that which one would expect from fall-out. Using the method described in this report, it was established that the maximum allowable exposure to Polaroid 3000x medical radiographic film of nuclear fall-out radiation is about 1R. Exposure to total accumulated dosages in excess of 1R renders this film useless for diagnostic use. Any shielding would have to insure that the total exposure from fall-out to this film is less than 1R and preferably less than 0.5R. (auth)

41517 FREE RADICAL REACTIONS IN UV IRRADIATION OF CELLULOSE. Theodor N. Kleinert. Holzforschung, 18: 24-8(Apr. 1964).

Free radical formation during uv irradiation of cellulose was studied by electron spin resonance (ESR) in two sets of experiments, namely, uv irradiation of sheets in air with ESR measurement of the specimens after storage in air, and uv irradiation of small cellulose samples in the cavity of an ESR spectrometer, with immediate recording of the signals. In the latter series of experiments, uv irradiation was carried out in vacuum, and also in oxygen and in nitrogen respectively. In both sets of experiments, the time of uv irradiation was varied, with the special objective to study the effects of the early stages of irradiation. Free radical formation was found in all cases studied. Irradiation also induced changes in peroxide formation, viscosity, copper number, solubility in boiling 1% sodium hydroxide solution, and optical properties. (C.H.)

41518 EFFICIENT LABELLING OF SERUM PROTEINS WITH I^{131} USING CHLORAMINE T. V. Bocci (Università, Siena, Italy). Intern. J. Appl. Radiation Isotopes, 15: 449-56(Aug. 1964).

Serum proteins, from several animal species were iodinated with ^{131}I by using chloramine T as the oxidizing agent. High labeling efficiency (60 to 65%) could be obtained using a protein: chloramine T ratio of about 250 : 1 provided that oxidation was allowed to proceed for at least 30 min. Tungstophosphoric acid soluble radioactivity was 2.0 to 5.0% and could be further reduced by dialysis. Starch-gel electrophoretic and autoradiographic examinations of serum ^{131}I-proteins did not reveal alteration of proteins. The biological behavior of guinea-pig sera labeled with ^{131}I by either the iodine monochloride or chloramine T methods were compared and the results suggested that the latter method was reproducible and did not change the proteins adversely. (auth)

41519 THE USE OF SILICONIZED GLASS VIALS IN PREVENTING WALL ADSORPTION OF SOME INORGANIC RADIOACTIVE COMPOUNDS IN LIQUID SCINTILLATION COUNTING. C. P. Petroff, P. P. Nair, and D. A. Turner (Sinai Hospital of Baltimore, Inc.). Intern. J. Appl. Radiation Isotopes, 15: 491-4(Aug. 1964).

Serious errors may result in the assay of some inorganic compounds by liquid scintillation counting due to the adsorption of these materials on the walls of glass counting vials. This report deals with the use of siliconized glass counting vials to prevent the wall adsorption of ^{32}P and ^{45}Ca-labeled materials. (auth)

41520 COMPARATIVE E.S.R.-MEASUREMENTS OF RADICAL PRODUCTION IN AMINO ACIDS BY ^{210}Po ALPHA- AND ^{60}Co GAMMA-RADIATION. Adolf Mueller, Philip E. Schambra, and Eleonore Pietsch (Kernforschungszentrum, Karlsruhe, Ger.). Intern. J. Radiation Biol., 7: 587-99(Dec. 1963).

The spectra and radical yields for eight different amino acids after irradiation with ^{210}Po α particles were investigated by ESR spectroscopy, and compared to those for ^{60}Co γ and x rays. Radical concentration as a function of α dose was determined, as well as the effect of storage time on the radical concentration and amplitude of the first derivative signal. The hyperfine spectra obtained from the aromatic amino acids after α irradiation were identical with those observed after γ irradiation, in contrast to findings for aliphatic amino acids. After α irradiation, the radical yields of the aliphatic amino acids were about a factor of six less than those obtained with γ rays, while for the aromatic amino acids the reduction in yield was much smaller. With post-irradiation storage time, a stronger reduction in radical concentration was observed after α irradiation than that reported after x irradiation. The dependence of radical concentration on radiation dose was compared for α and x rays. The typical saturation of radical concentration was found to occur independently of the actual concentration reached and at nearly equal doses of different radiations. (auth)

41521 THE EFFECTS OF TEMPERATURE AND EXCITATION DENSITY ON THE ATTENUATION OF α SCINTILLATIONS IN ZnS–Cu AND ZnS–Ag. V. S. Bezel and F. F. Gavrilov (Ural Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 4, 119-23(1964). (In Russian)

The duration and damping of ZnS–Cu and ZnS–Ag luminescence excited by ^{239}Pu α particles at 1 to 5 Mev were investigated. During initial stages the damping curve is represented as a sum of two exponents. The studies were carried out at 20 and 170°C. At lower temperatures the duration increased, especially, when the phosphor had been previously illuminated by ultraviolet light. (tr-auth)

41522 EFFECTIVE CROSS SECTIONS OF γ-RAY INDUCED DEFECTS IN GALLIUM ARSENIDES. M. A. Krivov and S. V. Molyanov (Tomsk State Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 4, 147-51(1964). (In Russian)

Calculations were made of the effective atomic shift cross sections in Ga, As, and GaAs for 1.25-Mev γ radiation. Experimental data are given for the effective cross sections in p-GaAs at the 0.05-ev level. (tr-auth)

41523 INHIBITION OF LIGHT-INDUCED REACTIONS BY MERCAPTANS AND DISULFIDES. BENZOPHENONE–BENZHYDROL AND ACETOPHENONE–α–METHYLBENZYL ALCOHOL. Saul G. Cohen, Daniel A. Laufer, and Warren V. Sherman (Brandeis Univ., Waltham, Mass.). J. Am. Chem. Soc., 86: 3060-8(1964).

Photoreductions in benzene of $(C_6H_5)_2C=O$ by $(C_6H_5)_2CHOH$ and of $C_6H_5COCH_3$ by $C_6H_5CH(OH)CH_3$, in which only a single intermediate radical, $(C_6H_5)_2\dot{C}-OH$ and $C_6H_5\dot{C}(OH)CH_3$, respectively, is formed, were retarded by 2-mercaptomesitylene–mesityl disulfide in $10^{-3}-10^{-2}\underline{M}$ concentration. The one radical was oxidized to ketone by disulfide and reduced to carbinol by mercaptan. Mercaptan and disulfide showed equal effectiveness, each being converted to the same mixture of the two during the irradiation. The sulfur compounds were used repeatedly, each molecule negating the chemical action of many quanta. Inhibition of photoreduction of $(C_6H_5)_2C=O$ by $(CH_3)_2CHOD$ led to $(CH_3)_2CDOH$. Retardation of reduction of $C_6H_5COCH_3$ in optically active $C_6H_5CH(OH)CH_3$ led to racemization, and in $C_6H_5CH(OD)CH_3$ led to $C_6H_5CD(OH)CH_3$. The pairs $(C_6H_5)_2C=O$ and $(C_6H_5)_2CHOH$, $C_6H_5COCH_3$ and $C_2H_5CH(OH)$-CH_3, $(C_6H_5)_2C=O$ and $(CH_3)_2CHOH$, and $C_6H_5COCH_3$ and $(CH_3)_2CHOH$ showed increasing sensitivity in this order to the retarding action of the sulfur compounds, the last two pairs being quite similar. The ease of transfer of a hydrogen atom from mercaptan to the alcohol-derived radical dominated the order of reactivity in these systems. Rate constants for transfer of hydrogen from $(CH_3)_2CHOH$ and from $C_6H_5CH(OH)CH_3$ to triplet acetophenone, and from $(CH_3)_2CHOH$ to triplet benzophenone, were in the range 10^5 to 10^6 liters mole^{-1} sec^{-1}. Rate constants for transfer of hydrogen from 2-mercaptomesitylene to acetophenone-ketyl radical and to benzophenone-ketyl radical, and from benzyl mercaptan to acetophenone-ketyl radical were in the range 10^3 to 10^4 liters mole^{-1} sec^{-1}. (auth)

41524 LUMINESCENCE PHENOMENA IN GAMMA-IRRADIATED PURE 3-METHYLPENTANE GLASS: IMPLICATIONS FOR RADIATION CHEMISTRY. Milton Burton, Michael Dillon, and Robert Rein (Univ. of Notre Dame, Ind.). J. Chem. Phys., 41: 2228-35(Oct. 15, 1964).

Gamma irradiation of 3-methylpentane glass at 77°K causes prolonged luminescence at that temperature with a decay law resolvable into three first-order decays with specific rates of the order of 10^{-3} sec^{-1}. Activation energies for the release of this isothermal luminescence are tightly grouped around a value near 0.1 ev. Additional luminescence produced in a warmup region corresponds to activation energies broadly grouped near 0.25 ev. Absorption of infrared light causes rapid release of isothermal luminescence but has no observable effect on warmup luminescence. Added quenchers affect both parts. The spectrum of the luminescence seems to be unaffected by the temperature or other treatment of the sample. Results are interpreted in terms of release of weakly trapped electrons and their interaction with positive holes to yield emitting states. The results suggest that in the radiation chemistry of condensed systems at room temperature some of the electron-neutralization processes require $>10^{-11}$ sec for their completion. During this time the positive holes involved can react chemically with their environs. (auth)

41525 LUMINESCENCE IN MIXED SOLVENT SYSTEMS: FACTORS RESPONSIBLE FOR A LUMINESCENCE MINIMUM. Milton Burton, Michael A. Dillon, Charles R. Mullin, and Robert Rein (Univ. of Notre Dame, Ind.). J. Chem. Phys., 41: 2236-42(Oct. 15, 1964).

Certain solutions containing a mixture of two solvents one of which is benzene, a scintillator (at fixed concentration) and air (also at fixed concentration) when irradiated with ^{60}Co γ rays are known to yield luminescence, the intensity of which is a minimum at benzene concentration near 1 vol %. A light-yield expression, analytically developed by others to explain this minimum, is examined and interpreted. It is shown theoretically and experimentally that the minimum can be made to disappear at sufficiently high concentration of scintillator solute, that the presence of air or other quencher is not in principle essential to the existence of a minimum, that the properties of benzene (the better solvent) pertinent to the effect are not affected by the presence of other solvent, that such necessary properties are establishable and selection of the better solvent can be deliberately made to conform to those properties, and that other solvent pairs of the required characteristics can be found. The results are interpreted in terms of structure of the liquid. (auth)

41526 RADIOLYSIS OF CYCLOHEXANE-CYCLOHEXENE-1-^{14}C SOLUTIONS. Mark Cher, C. S. Hollingsworth, and B. Browning (North American Aviation Science Center, Canoga Park, Calif.). J. Chem. Phys., 41: 2270-4 (Oct. 15, 1964).

Radiolysis of solutions of 1% cyclohexene-1-^{14}C in cyclohexane with ^{60}Co γ rays yields radioactive cyclohexane, bicyclohexyl, cyclohexylcyclohexene, and bicyclohexenyl. Measurements were made of the total yield of these products, their specific activity, the total yield of hydrogen, and also the yield of hydrogen from pure cyclohexane. It is shown by material and radioactive balance considerations based on a simplified free radical mechanism, together with some known kinetic data, that a major fraction of the decrease in the H_2 yield relative to that in pure liquid cyclohexane can be accounted for in terms of the reactions of H atoms with cyclohexene and the resulting formation of the radioactive C_6H_{11} and C_6H_9 radicals. Detailed analysis shows that the specific rate of addition of H atoms to cyclohexene is 41 times greater than the specific rate of abstraction by H atoms from cyclohexane, and that the molecular (unscavengeable) and free radical yields in the irradiation of pure cyclohexane are, respectively, 1.7 and 3.7 molecules/100 ev. The latter conclusion is in fair agreement with results obtained by others, but is in sharp contrast with recent results of Dyne. A plausible explanation is suggested to reconcile the discrepancy between the two sets of results. (auth)

41527 METHANE–TRITIUM SYSTEM. II. KINETICS OF THE EXCHANGE REACTION. Richard J. Kandel (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 41: 2435-42(Oct. 15, 1964). (LADC-6294)

The rates of the reactions of CH_4 with T_2 to give, successively, CH_3T, CH_2T_2, CHT_3, and CT_4, and of the reverse reactions of the tritiated molecules with protium were measured. Second-order rate constants were obtained from the data, and radiation yields were determined. The reactions were shown to follow two paths. Beta decay energy deposited in the tritium resulted in an exchange reaction in which approximately one exchange took place per ion pair formed. Energy initially deposited in the methane resulted in six exchanges per ion pair. Equilibrium constants were calculated from the steady-state concentrations and were shown to be close to the high-temperature, classical values. Hot atom, ion, and radical reactions are believed to play a predominant role in the exchange. (auth)

41528 ESR SPECTRA OF X-IRRADIATED N-ALKYLUREAS. Phillip Hamrick and Howard Shields (Wake Forest Coll., Winston-Salem, N. C.). J. Chem. Phys., 41: 2560-1 (Oct. 15, 1964).

Electron spin resonance spectra were observed for a series of x irradiated N-alkylureas: N-n-butylurea, N-isobutylurea, N-isopropylurea, and N-t-butylurea. The radicals produced in the N-alkylureas are similar in structure to those previously reported by others for n-methyl and N-ethylurea, wherein a hydrogen atom is lost by the carbon atom bonded to nitrogen. There was no evidence of triplet splitting that would result from an interaction with the nitrogen nucleus. The data indicate that irradiation normally breaks a bond to the α carbon in the alkylureas to leave a free radical. The unpaired electron on the α carbon interacts with neighboring hydrogens to give typical ESR hyperfine patterns. (P.C.H.)

41529 LUMINESCENCE DECAY TIMES IN X-RAY-IRRADIATED SCINTILLATOR SOLUTIONS. Milton Burton, Peter K. Ludwig, M. Scholastica Kennard, and Richard J. Povinelli (Univ. of Notre Dame, Ind.). J. Chem. Phys., 41: 2563-5(Oct. 15, 1964).

A table that reflects both current knowledge and the current limitations of interpretation of decay times is reported. In general, at least two scintillator decay processes appear, a short one associated with single molecules and a longer one attributed to excited dimers. Decay parameters of terphenyls, 1,4-diphenyloxazole, phenylbiphenylyloxadiazole, 9, 10-dibromoanthracene, 1,6-diphenylhexatriene, and 2-(1-naphthyl)-5-phenyloxazole in organic solvents irradiated by 30-kv x rays are included. (P.C.H.)

41530 EFFECT OF HIGH-ENERGY RADIATION ON THE RATE OF REACTION BETWEEN MAGNESIUM POWDER AND OXYGEN. Clement Campbell and Eli S. Freeman (Picatinny Arsenal, Dover, N. J.). J. Chem. Phys., 41: 2565-6(Oct. 15, 1964).

Studies were made on the effects of gamma and neutron irradiations on the rate of the reaction between Mg powder and oxygen. The experimental results showed that the rate of reaction of Mg powder with oxygen was significantly increased after irradiation. This was true for both exposure to ^{137}Cs gamma rays and exposure to reactor radiation. Using the value of 40 kcal/mole for the activation energy for the oxidation of the irradiated Mg powder, the heat of adsorption of oxygen on the irradiated metal surface was estimated to be -19 kcal/mole O_2. (P.C.H.)

41531 PARAMAGNETIC ABSORPTION OF L-CYSTINE DIHYDROCHLORIDE IRRADIATED AT LOW TEMPERATURE. Harold C. Box and Harold G. Freund (Roswell Park Memorial Inst., Buffalo). J. Chem. Phys., 41: 2571(Oct. 15, 1964).

Studies were made on the paramagnetic absorption of L-cystine dihydrochloride irradiated at 4.2°K. The two principal components of the absorption spectrum, designated α and β, are due to positive and negative ions in which the unpaired electron is localized primarily on the disulfide group. The ions give rise to a single absorption pattern. There is a large g-value variation due to spin-orbit coupling as expected for sulfur electrons. In the case of the α absorption the hyperfine pattern indicates an interaction between the unpaired electron and the protons of the adjacent CH_2 groups. Upon warming, the paramagnetic absorption spectrum undergoes a sequence of changes until finally, after several hours at room temperature, the stable absorption previously reported by others is obtained. (P.C.H.)

41532 RESEARCH OF RADIOISOTOPE PRODUCTION WITH FAST NEUTRONS. VI. PREPARATION OF Cu-67. Eiji Shikata (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 1: 177-80(Aug. 1964).

The production of ^{67}Cu by the ^{67}Zn(n,p)^{67}Cu reaction in reactor irradiation of Zn enriched to 93.4% in ^{67}Zn was investigated. The ^{67}Cu in the target was separated by anion exchange using the chloro-complex of the metals. Seventeen mμC of ^{67}Cu were obtained from 1 mg of Zn. No radioactive impurities other than ^{64}Cu were found. Even with the enriched target, more ^{64}Cu than ^{67}Cu was produced. (D.C.W.)

41533 RADIATION-INDUCED POLYMERIZATION OF ACRYLONITRILE IN LIQUID ETHYLENE. Yoneho Tabata, Kiyoshi Hara, and Hiroshi Sobue (Tokyo Univ.). J. Polymer Sci., Pt. A, 2: 4077-86(Sept. 1964).

A mixed system of acrylonitrile and ethylene was irradiated with γ rays from a ^{60}Co source at -78°C. In the mixed system, ethylene did not polymerize, and only acrylonitrile polymerized. It was found that polymerizations due to both $C=C$ double bond and the $C\equiv N$ triple bond of acrylonitrile occurred in the mixed system. The ratio of one type of polymerization to the other varied continuously with concentration of the monomer; the polymerization of $C=C$ only occurs in bulk (100% monomer), as well known, but on the other hand, the polymerization of $C\equiv N$ occurs predominantly in a dilute solution of the monomer. The polymerization due to $C\equiv N$ triple bond would be by an ionic mechanism, probably an anionic. The experiments showed that the polymerization of acrylonitrile in the ethylene solution proceeds by a partial ionic mechanism at moderate concentrations of the monometer. The product obtained by the polymerization in such a mixed system is a mixture of polymers. (auth)

41534 X-RAY-INDUCED POLYMERIZATION OF DIPHENYLVINYLPHOSPHINE OXIDE. H. R. Allcock (American Cyanamid Co., Stamford, Conn.). J. Polymer Sci., Pt. A, 2: 4087-95(Sept. 1964).

Diphenylvinylphosphine oxide was polymerized in the molten state by x irradiation to give polymers with molecular weights up to 10,000. The results of variations in total radiation dose, dose rate, and temperature, are consistent with a free radical polymerization mechanism in which chain transfer is important. Infrared spectra of the polymers provided evidence that phenyl groups are involved in the chain transfer processes. (auth)

41535 RADIATION-INDUCED ELECTRICAL CONDUCTIVITIES IN POLYAMIDE COPOLYMERS. Peter Hedvig (Plastics Research Inst., Budapest). J. Polymer Sci., Pt. A, 2: 4097-4103(Sept. 1964).

Radio-induced conductivities as high as 10^{-12} ohm^{-1} cm^{-1} were measured in polyamide copolymers irradiated by x rays and ^{60}Co γ rays at dose rates of 0.1-20 R/sec. No temperature dependence for the induced conductivities could be detected between 10 and 60°C, while dark conductivities followed the usual exponential rule with activation energies between 1 and 2 ev. Preirradiation of the samples resulted in a decrease of the induced conductivities. This effect could be controlled by addition of benzophenone and hydroquinone. A phenomenological model is presented for a possible explanation of the results. (auth)

41536 THE GRAFTING OF STYRENE ONTO POLYETHYLENE BY RADIATION OF LOW INTENSITY. J. Dobo and T. Czvikovszky (Research Inst. for the Plastics Industry, Budapest). J. Polymer Sci., Pt. B, 2: 939-41(Oct. 1964).

Studies were made on the grafting of styrene onto polyethylene by irradiation at 25°C in vacuo, using a cobalt source of 320°C. The grafting percentage was determined by weight increase after soaking in benzene for 24 hr. The grafting curves showed some slowing down of the reaction time. Films grafted for longer times developed macroscopic bubbles. It is suggested that in grafting some rapid termination or recombination reactions become effective at higher intensities. Thus at low intensities, radiation grafting can be treated by conventional polymerization kinetics. Both complications caused by the depletion of monomer in the film and radical concentration saturation effects can be avoided. (P.C.H.)

41537 TRANSVINYLENE FORMATION IN GAMMA IRRADIATED POLYETHYLENE. R. C. Giberson (General Electric Co., Richland, Wash.). J. Polymer Sci., Pt. B, 2: 951-3(Oct. 1964).

The effects of dose rate on the transvinylene formation in gamma irradiated polyethylene are illustrated. Previous results reported by others are discussed. (P.C.H.)

41538 DYNAMIC MODULUS PROPERTIES OF SOME POLYMERS DURING GAMMA IRRADIATION. Robert K. Jenkins (Northrop Space Labs., Hawthorne, Calif.). J. Polymer Sci., Pt. B, 2: 999-1003(Oct. 1964).

The dynamic moduli changes of two filled silicone and one filled Hypalon elastomer, previously vulcanized, were studied continuously in situ during exposure to gamma radiation from a ^{60}Co source. The dynamic moduli properties were calculated by continuously monitoring a miniaturized vibrating reed apparatus from which the forced displacement of the clamped end and the resonance displacements of the free end of the polymer were recorded. A clearly defined initiation period was required for each polymer before a steady crosslink yield, G(c.l.), was obtained as evidenced by a constant rate of change of the modulus with exposure. No significant change in the loss tangent was apparent during or after a total dosage of 6×10^7 R. (P.C.H.)

41539 THERMAL ANNEALING OF TELLURIUM RESULTING FROM ISOMERIC TRANSITION IN SOLID SODIUM TELLURATE. D. Dancewicz and A. Halpern (Inst. of Nuclear Research, Warsaw). Nature, 203: 856-7(Aug. 22, 1964).

Experiments are described which show that thermal annealing does not influence the yield of ^{127}Te as Te(IV) and Te(VI) from isomeric transition of tellurium-127m in labeled sodium tellurate. (H.M.G.)

41540 THERMAL DECOMPOSITION OF BARIUM AZIDE. E. G. Prout and D. J. Moore (Rhodes Univ., Grahamstown, South Africa). Nature, 203: 860-1(Aug. 22, 1964).

The effects of pre-irradiation with 1-Mev gamma rays on the thermal decomposition of dehydrated barium azide crystals were studied. The induction period was practically eliminated, and decomposition was accelerated. (D.C.W.)

41541 A NEW METHOD OF DETERMINATION FOR SOME GASEOUS FISSION PRODUCTS. A. Bouville and J. Fontan (Faculte des Sciences, Toulouse). Onde Elec., 44: 610-13(May 1964). (In French)

A method and system for the separation and determination of certain radioisotopes of Kr and Xe are described. (D.C.W.)

41542 PHONON-FREE COLOR CENTER TRANSITIONS IN NaF SINGLE CRYSTALS. G. Johannson, W. von der Osten, M. Schinkmann, and W. Waidelich (Technische Hochschule, Darmstadt, Ger.). Phys. Letters, 11: 210-11 (Aug. 1, 1964). (In German)

In NaF exposed to strong x radiation for 100 hr, approximately 40 lines were observed in the visible spectral range. The crystals were then subjected systematically to various temperature treatments between 373 and 490°K. The half-value width of the line decreased with decreasing temperature. The spectral positions and the intensity of the lines found at 4°K were tabulated. The absorption spectrum was decomposed by thermal treatment, and a partial classification of the zero-zero transition to individual bands was made. A large number of weak unknown absorption bands, which were indicated by their phonon-free electron transitions, occurred. Large aggregates of color centers were suggested as the origin of these bands. (J.S.R.)

41543 EFFECT OF LEAD ON THE ROOM-TEMPERATURE COLORABILITY OF KCl. W. A. Sibley, E. Sonder, and C. T. Butler (Oak Ridge National Lab., Tenn.). Phys. Rev., 136: A537-41(Oct. 19, 1964).

The introduction of F centers in Pb-doped KCl by ionizing radiation was measured as a function of lead content for different radiation intensities. For the lowest intensity (gamma irradiation), as little as 0.5-ppm impurity caused a marked decrease in the late-stage coloration and less than 100 ppm completely suppressed the late stage. Lead impurities are less effective in decreasing late-stage colorability when higher irradiation intensities (electron irradiation) are used. These results suggest that previously observed variations in the late-stage coloration characteristics could be due to trace amounts of impurities of the order of 1 ppm. Furthermore, it is suggested that these trace impurities are not depleted during irradiation, but affect the late-stage colorability by acting as electron or hole traps, or as recombination centers. (auth)

41544 THE INFLUENCE OF PLASTIC DEFORMATION ON THERMAL BLEACHING OF COLOR CENTERS IN POTASSIUM CHLORIDE CRYSTALS IRRADIATED BY γ RAYS. J. Z. Damm and J. Kowalczyk (Inst. of Structural Research, Polish Academy of Sciences, Wroclaw). Phys. Status Solidi, 6: 693-8(Sept. 1, 1964).

Thermal bleaching of F centers in the temperature range between 106 and 185°C was found to occur in plastically deformed KCl crystals as well as in non-deformed ones. In both cases the activation energy of the process was found to be equal to 1.30 ± 0.02 ev per F center. The bleaching mechanism is considered to arise from the diffusion of anion vacancies. The decrease of the bleaching rate in deformed material is tentatively explained by the increase of the mean "micrograin" diameter. (auth)

41545 PREPARATION OF TRITIUM-LABELED COMPOUNDS BY THE ELECTRIC DISCHARGE METHOD. Hikaru Shimojima, Hiroyuki Nagao, and Toshimasa Kamada. Radioisotopes (Tokyo), 13: 287-92(July 1964). (In Japanese)

The method of preparing tritium labeled compounds was studied using high voltage discharge and microwave discharge. This method can be widely applied to various compounds including complicated ones that are not easily prepared with usual techniques. Labeled compounds with high specific activities were found to be easily prepared in a short period in comparison to the contact method or recoil labeling method. The microwave discharge technique was found to be superior to the high voltage discharge technique because of a simple discharge reactor tube and smaller production of impurities that have to be removed. Tritium labeled acetic acid was prepared with various conditions. For the purification of reactants, precise distillation and gas chromatographic techniques were applied after esterification of acetic acid. Labile tritium was completely removed while the purifications of the reactant were made. (auth)

41546 RADIATION CHEMISTRY OF THE FIXATION OF NITROGEN. P. Harteck and S. Dondes (Rensselaer Polytechnic Inst., Troy, N. Y.). Science, 146: 30-5(Oct. 2, 1964).

Developments, unresolved problems, and some indications of possible solutions in the radiation chemistry of the fixation of nitrogen are discussed. The term fixation of nitrogen denotes the chemical binding of nitrogen gas of the air to form a chemical compound. There are two possible avenues to a breakthrough to make the chemonuclear-reactor production of fixed nitrogen in the form of NO_2 an economical commercial process. One is steady systematic research on the nitrogen fixation process, and steady development to achieve higher yields and lower costs, so that, relative to the rising prices of natural gas, a break-even point can be reached; the other is some lucky innovation by means of which G_{NO_2} equal to 10 or more may be achieved. (P.C.H.)

41547 BETA-RADIOLYSIS OF LIQUID BENZENE. E. A. Cherniak, E. Collinson, and F. S. Dainton (Univ. of Leeds, Eng.). Trans. Faraday Soc., 60: 1408-23(Aug. 1964).

Various methods were used, including the chromatographic analysis of non-gaseous products and free radical detection with ferric chloride, to investigate the mechanism of the $^{90}Sr-^{90}Y$ beta radiolysis of liquid benzene. The initial G for reduction of $FeCl_3$ is strongly dependent on $[FeCl_3]$ and may be as high as 10; it falls rapidly with increasing dose to a constant value of 0.86 ± 0.12. It was concluded that the most important primary act leads to the formation of phenyl radicals and hydrogen atoms, together with electronically excited benzene molecules of two types, one with a lifetime of ~100 μsec tentatively assigned to the $^3B_{1u}$ state and the other, of shorter life, which may be the $^1B_{2u}$ state. The C_6H_5 radicals and H atoms are very reactive toward benzene, and $FeCl_3$ scavenges only secondary, less reactive, radicals but can also be decomposed by interaction with a benzene molecule in either state of excitation. (auth)

41548 NATURE OF THE FREE RADICALS FORMED IN IRRADIATED POLYDIMETHYLSILOXANES. A. S. Kuzminskii, T. S. Fedoseeva, Ya. S. Lebedev, A. L. Buchachenko, and E. V. Zhuravskaya (Scientific Research Inst. of Rubber Industry, Academy of Sciences, USSR and Inst. of Chemistry Physics, Academy of Sciences, USSR). Vysokomolekul. Soedin., 6: 1308-12(July 1964). (In Russian)

Properties of free radicals formed in γ-irradiated polydimethylsiloxane (PDMS) and its phenyl-containing derivatives were studied, and the relation between the character of the radicals formed in the polymers and the physical properties of the polymer matrix was analyzed. The electron paramagnetic resonance spectra for PDMS presented a superimposed singlet and triplet structure depending on the radicals. The formula was obtained for determining concentration of both types of radicals in PDMS irradiated at −196°. (R.V.J.)

41549 DETERMINATION OF POLARON YIELD IN Co^{60} GAMMA IRRADIATION IN AIR-CONTAINING AQUEOUS SOLUTIONS OF DIETHYL THALLIUM SULFATE. D. Sarrach (Institute fur Medizin und Biologie, Deutsche Akademie der Wissenschaften, Berlin). Z. Anorgan. Allgem. Chem., 330: 290-4(Aug. 1964). (In German)

Aerated aqueous solutions of diethyl thallium sulfate were irradiated with ^{60}Co-gamma rays and analyzed polarographically. The addition of sulfuric acid reduced the yield of thallium(I) ions in a manner that can be explained kinetically by competition between H_3O^+ ions and $(C_2H_5)_2Tl^+$ ions for the solvated electrons of water radiolysis. The yield of polarons was determined to $G_{e^-aq} = 2.81 \pm 0.18$. Thus all reducing radicals of water radiolysis were primarily found in the form of solvated electrons. (auth)

41550 A METHOD FOR DETECTION OF SLOW ELECTRONS FROM EXCITATION AND IONIZATION OF MOLECULES BY ELECTRON COLLISIONS. G. Jacobs and A. Henglein (Hahn-Meitner-Institut für Kernforschung, Berlin and Mellon Inst., Pittsburgh). Z. Naturforsch., 19a: 906-10(July-Aug. 1964). (In German) (RRL-136)

A new type of secondary negative ion was found in mixtures of "indicator compounds" such as methyl iodide and sulfur hexafluoride with sulfur dioxide, carbon disulfide, xenon, and many other substances. It is shown that the precursors of these secondary ions are free electrons of low kinetic energy which are produced in collisions of fast electrons with gas molecules. For example, sulfur dioxide was found to possess three discrete levels between about 2 and 8 ev, which are freuqently excited by electrons according to $SO_2 + e^- \rightarrow SO_2^* + e_0^-$, where the electron e_0^- has nearly no kinetic energy and therefore is readily captured by an indicator molecule. Similarly, slow electrons were found to be formed in various excitation and ionization processes (including double and triple ionization) in xenon. This "indicator" method may generally be used to study excitation and ionization processes in which slow electrons are produced. (auth)

41551 γ RADIATION CHEMISTRY OF REACTIONS OF WHITE PHOSPHORUS IN CYCLOHEXANE AND CYCLOHEXANE-CARBON TETRACHLORIDE SOLUTIONS. K.-D. Asmus, A. Henglein, G. Meissner, and D. Perner (Hahn-Meitner-Institut für Kernforschung, Berlin). Z. Naturforsch., 19b: 549-57(July 1964). (In German)

Red phosphorus, soluble phosphorus organic compounds, and small amounts of phosphine are formed when white phosphorus in cyclohexane solution is exposed to γ rays. The red phosphorus contains one C_6H_{11}-group per 4−5 P-atoms. It reacts with chlorine to give cyclohexylphosphorus-dichloride. Its reactivity toward oxygen can be decreased by high temperatures during irradiation or by high γ doses. It was concluded from quantitative studies of this annealing process that phosphorus atoms carrying C_6H_{11}-endgroups are especially reactive in the polymeric form of phosphorus. The low molecular weight products of the reaction between white phosphorus and cyclohexane undergo typical reactions of tertiary phosphines. They can readily be oxidized and chlorinated to yield cyclohexyl-phosphinic-acid or cyclohexyl-phosphorus-dichloride, respectively. White phosphorus acts as a scavenger for free H-atoms and C_6H_{11}-radicals from the radiolysis of cyclohexane. This reaction, however, generally does not lead to the complete cracking of all PP-bonds of the P_4-molecule. The following products are formed in the γ irradiation of white phosphorus in cyclohexane in the presence of carbon tetrachloride: Red phosphorus containing C_6H_{11}- and CCl_3-endgroups, cyclohexylphosphorus-dichloride, trichloromethyl-phosphorus-dichloride, chloroform, cyclohexyl-chloride, hexachloroethane, and trichloromethyl-cyclohexane. The yields of these products at various doses, dose rates, temperatures, and compositions of the solutions are described. Several products such as $C_6H_{11}PCl_2$ are produced with high G-values at temperatures above 100°C. The results are explained by a reaction scheme in which three chain reactions occur simultaneously. They are linked together since they have a common intermediate in the form of the CCl_3-radical. At high doses, the reaction products of phosphorus mentioned above (including the red phosphorus) are transformed into soluble organic phosphorus compounds of high boiling points the structure of which has not yet been recognized. (auth)

41552 RADIATIVE DECOMPOSITION OF γ-IRRADIATED METHIONINE. V. T. Kharlamov and L. P. Shubnyakova. Zh. Prikl. Khim., 37: 1714-18(Aug. 1964). (In Russian)

Synthesized methionine-^{35}S with a specific activity of 1 μC/g was analyzed by paper chromatography. Observation of γ-irradiated powder specimens and their aqueous solutions in air and in inert atmospheres showed a strong oxygen effect on radiochemical decomposition. (R.V.J.)

41553 A STUDY OF THE POLYMERIZATION OF CYCLOPENTADIENE INITIATED BY IONIZING RADIATION. William Ralph Busler. Thesis, Knoxville, Tenn., Univ. of Tennessee, 1963. 102p.

Cyclopentadiene was obtained by the thermal cracking of dicyclopentadiene. The monomer was dried by passing the liquid through a column packed with activated silica gel and degassed by the usual method of freezing, evacuating, and melting. Sample bulbs were filled by distillation of the monomer in vacuo. All irradiations were carried out at −78° in calibrated positions of a lead-shielded cobalt-60 gamma source. The pure monomer was found to polymerize with a $G(-C_5H_6)$ of 21,780 ± 2240. The amount of conversion is directly proportional to the absorbed dose. No dose rate effect was observed. For conversions in excess of 0.5 per cent, the polymer is highly cross-linked and becomes less soluble as the percentage conversion is increased. Oxygen and DPPH are relatively ineffective as inhibitors whereas the polymerization is strongly retarded by small concentrations of ammonia and simple amines. Irradiation of solutions of cyclopentadiene in n-hexane showed that the solvent acted essentially as an inert diluent. Some polymeric amine was formed when cyclopentadiene was polymerized in the presence of ammonia. The infrared spectra of polycyclopentadiene formed from pure monomer and in the presence of ammonia were recorded. The proton magnetic resonance spectrum of polycyclopentadiene in carbon tetrachloride was recorded. The yield of ions that propagate to polymer was calculated. An average value of 0.23 ions/100 ev was obtained. A dilatometric study of the polymerization in which ammonia was present as a retarder was carried out. The data of this study were employed to obtain a value of the propagation rate constant of 1.2×10^7 l/mole, sec. It was found that the mean lifetime of propagating ions in the polymerization of pure cyclopentadiene is 6×10^{-4} sec. (Dissertation Abstr., 25: No. 1, 1964)

41554 STUDIES OF IRRADIATED POLYETHYLENE. Michael Byers Fallgatter. Thesis, Evanston, Ill., Northwestern Univ., 1963. 125p.

Various aspects of the radiation chemistry of linear and highly branched polyethylene were considered. The conclusions of others with respect to the mode of decay of initial unsaturation are supported, but conclusions as to the mode of vinylene growth are not. Studies of the distribution of the vinylene groups produced during irradiation indicate that these groups are evenly distributed between sol and gel, which is interpreted to mean that the mechanism of the crosslinking reaction in polyethylene does not involve vinylene groups or allyl radicals. Plots of the Charlesby-Pinner function for gel formation in both linear and branched polyethylene show much greater curvature than is predicted by theory. Studies of the ultraviolet spectrum of linear polyethylene after irradiation in vacuum at room temperature show that maxima occur at 236, 274, 285, 310, 323 and 393 mu, and these maxima are identified as being due to diene, triene, allyl, tetraene, dienyl, trienyl and tetraenyl groups respectively. The allyl radical concentration increases linearly with dose while the rate of diene formation is initially constant, but decreases at high doses. The growth of higher polyenes and polyenyl radicals may be linear after an initial induction period. A portion of the polyenyl radicals in irradiated linear polyethylene decays upon exposure to air, but a portion is highly resistant to oxidation. The results of a limited number of studies of samples irradiated at 77°K or in the presence of benzene vapor at room temperature are reported. The rates of formation of gel, polyenyl radicals and conjugated unsaturation are lowered in the presence of benzene, as is the rate of decay of initial unsaturation, but the rate of vinylene formation is unaffected. Material balance considerations for the radiation chemical processes in polyethylene lead to the conclusion that crosslinking occurs to a substantially greater extent in branched than in linear polyethylene. A brief comparison is made of the observed ultraviolet absorption maxima of the polyenyl free radicals with values derived from quantum mechanical calculations. Calculation of the expected absorption maxima of the polyenyl radicals using the free electron model gives poor agreement with the observed values. (Dissertation Abstr., 25: No. 1, 1964)

41555 A STUDY OF FREE RADICALS IN IRRADIATED AMIDES BY ELECTRON SPIN RESONANCE SPECTROSCOPY. Sara-Jo Kleinheksel Bolte. Thesis, East Lansing, Mich., Michigan State Univ., 1963. 127p.

Polycrystalline amides representative of hydrocarbon substitution on both the nitrogen and the carbonyl carbon, and two related carboxylic acids were irradiated with 1-Mev electrons at liquid air temperature. The free radicals formed by irradiation were studied by electron spin resonance spectroscopy in the 9-kMc region at liquid air temperature, using a spectrometer built at Michigan State University and a Varian ESR spectrometer. The hyperfine spectra observed were used to determine the number and type of nuclei interacting with the spin of the unpaired electron and their isotropic coupling constants. From this information the free radicals formed by irradiation were identified and a scheme for the prediction of the site of radiation damage in some compounds is suggested. The radiation damage observed in the amides and acids occurred only within one of the alkyl groups of the molecule. An alkyl group bonded to the nitrogen of an amide was always attacked in preference to a group attached to the carbonyl carbon. In most cases a hydrogen was removed, but in some cases a carbon-carbon bond was broken rather than a carbon-hydrogen bond. The particular site of hydrogen removal within the alkyl group is found to be consistent with the following generalization: (1) a methyl carbon-hydrogen bond is broken only if no other carbon-hydrogen or carbon-carbon bond is present in the preferred alkyl group, (2) a proton is removed from a CH_2 group next to a methyl group in preference to a similar group adjacent to the nitrogen, (3) for a tertiary carbon the carbon-carbon bond to the carbonyl group is broken in preference to the carbon-carbon bond to a methyl group. Some anomalies appear when the only alkyl group present is adjacent to carbonyl. Branched alkyl groups give some extra spectral lines which could not be identified accurately, but which proably indicate the presence of small amounts of radicals other than the predominant species identified. (A.G.W.)

41556 DISTRIBUTION OF RADIOACTIVITY IN SOME ORGANIC COMPOUNDS, LABELLED BY THE REACTION ^{14}N(n,p)^{14}C. Richard Visser. Thesis, Amsterdam, Universiteit, 1963. 107p.

Information is included on: theoretical aspects of the recoil-labeling process; products formed by the reaction ^{14}N(n,p)^{14}C; activity distribution in a series of toluenes-^{14}C obtained by recoil-labeling; activity distribution in toluenes obtained by irradiation of toluene-1-^{14}C; influence of radiation on toluene; and activity distribution in quinoline-^{14}C obtained by recoil-labeling. (P.C.H.)

41557 RADIATSIONNYE EFFEKTY NA POVERKHNOSTYAKH GELEI. (Radiation Effects on Silica Gel Surfaces). Sh. A. Ablyaev and S. V. Starodubtsev. Tashkent, Publishing House "Science" Uzbek SSR, 1964. 121p.

Gamma and slow electron radiation effects on silica gel and synthetic zeolite surfaces were investigated. The effects of light on the surface properties of semiconductors and dielectrics were also investigated. (R.V.J.)

Separation Processes and Procedures

Refer also to abstract 41602.

41558 (ANL-6811) ANION EXCHANGE CHARACTERISTICS OF THE ELEMENTS IN NITRIC ACID AND NITRATE SOLUTIONS AND APPLICATION IN TRACE ELEMENT ANALYSIS. J. P. Faris and Robert F. Buchanan (Argonne National Lab., Ill.). July 1964. Contract W-31-109-eng-38. 29p.

The adsorption of most metal ions onto a strongly basic anion exchange resin from nitric acid solution has been determined. Distribution coefficients are given for some 70 elements in acid concentrations ranging from 0.1M to 14M. A comprehensive list of references to similar studies and to some typical uses of anion exchange separation in a nitric acid medium is included. The increased absorption of some elements from nitrate solutions of low acidity offer additional possibilities for analytical separations by anion exchange resins. Past work in inorganic nitrate solutions and in water-miscible organic solvent mixtures is reviewed briefly from the standpoint of possible use in trace element analysis. Some analytical procedures are outlined whereby trace impurities were concentrated by anion exchange in a nitrate medium and then determined by an emission spectrographic technique. Methods developed for the analysis of thorium, plutonium, and neptunium have utilized the large separation factors from most other ions in a nitric acid medium; differences in absorption from methanol-nitric acid mixtures have been applied to the analysis of the rare earths. Limits of detection by the copper spark method are given for more than 50 elements. (auth)

41559 (CEA-R-2496) PRECONCENTRATION DES MINERAIS D'URANIUM PAR TRIAGE RADIOMETRIQUE. (Preconcentration of Uranium Ores by Radiometric Sorting). Robert Avril and Jean Grenier (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Aug. 1964. 24p.

The uranium ore chemical treatment plant at Bessines-sur-Gartempe is supplied entirely by the La Crouzille Mining Division of the French Atomic Energy Commission mainly from mining districts of Fanay, Margnac, and Le BRUGEAUD in the Limousin province and also, for the remainder, by a certain amount of private production in the "Massif Central." The supply mixture, which is very heterogeneous, is enriched before being treated chemically. The pre-concentration operation is carried out in the divisions ore treatment work-shop. It consists in a stone removal operation using radiometric sorting along a continuous belt; this makes it possible to eliminate 50 per cent of the only fraction which is thus treated—that from 50 to 120 mm; it represents 15 to 20 per cent of the total tonnage supplied to the plant. (auth)

41560 (CEA-R-2508) ETUDE DU TRAITEMENT CHIMIQUE DES COMBUSTIBLES URANIUM-ZIRCONIUM PAR VOIE SECHE. (Study of the Chemical Treatment of Uranium-Zirconium Fuels by a Dry Method). Michel Bourgeois and Patrick Nollet (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Aug. 1964. 33p.

A dry process has been studied for separating the uranium from the zirconium either for recovering the enriched uranium from fuel element production waste, or with a view to treating this waste after irradiation. In this process the alloy is treated with hydrochloric acid at 400°C in a fluidized corundum bed which causes the zirconium to volatilize as tetrachloride and the uranium to form the trichloride. This latter is then converted to the hexafluoride by attack with fluorure. After the laboratory tests, a first pilot plant with a capacity of 1 kg of alloy was tried out at the Fontenay-aux-Roses Nuclear Research Centre; this made it possible to fix the operational conditions for the process. An industrial scale plant was then built with collaboration from Kuhlmann, and operated until a satisfactory process had been developed for treating the waste. This installation treats 3 kg/hr of alloy with a yield for the hydrochloric acid of about 50 per cent and with a uranium loss in the zirconium tetrachloride of about 0.1 per cent. An active pilot plant capable of treating a few kilos of irradiated alloy is now being studied. (auth)

41561 (EURAEC-884) RETREATMENT OF IRRADIATED FUELS. Quarterly Report No. 14, July 1–September 30, 1963. J. Schmets (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium). Work Performed under United States–Euratom Joint Research and Development Program. Contract 098-62-11RDB. 38p. (R-2259)

Efforts devoted to development of the $UO_2-U_3O_8$, $UO_2F_2-UF_4-UF_6$ cycle are described. A comparative study of the behavior of UO_2 at the time of oxidation in air was carried out. Irradiated and nonirradiated specimens, with or without fission products, as well as samples put into thermal equilibrium were compared. The closer the UO_2 crystalline lattice is to the ideal one, the slower the oxidation occurs. The introduction of flaws by irradiation leads to an increase in the oxidation rate which is more appreciable in more perfect lattices and lower oxidation temperatures. The presence of fissium slows down the oxidation rate. Oxidation-fluorination operations on a scale of 1 to 4 kg were continued. The purpose of these tests was to shorten the oxidation time. The complete oxidation, hydrofluorination, and fluorination cycle was linked up. Various metal prefilters for the ventilation system were tested. Their effectiveness may exceed 99.5% for U dust. Work on the $UO_2-UO_3-UF_6$ cycle is also described. The results obtained for the synthesis of UO_3 and for the reaction between UO_3 and SF_4, in the presence and in the absence of Pu, demonstrated that in the preparation of UO_3 on a large scale agglomerates form and preferential paths for the fluids appear. Transformation of UO_3 to UF_6 is slow in the presence of Pu and UF_4 is formed as a by-product. UF_4 may be converted into stoichiometric UO_2 by treatment in a molten salt medium. An increase in the total transformation rate was obtained by adding humidity to the bath and by improving the contact between the reactive agents and the NaCl–KCl eutectic. The use of PCl_5 and $POCl_3$ to treat UO_2 gives overall beta decontamination of 17 to 31% and gamma decontamination of 15 to 44%. Zr–Nb decontamination may exceed 90%. (auth)

41562 (KFK-215) UNTERSUCHUNGEN ZUM VERHALTEN VON SILIKAGEL ALS IONENAUSTAUSCHER TRENNUNG BLEI (Pb-212)–WISMUT (Bi-212)–THALLIUM (Tl-208) (thèse). (Investigation on Behavior of Silica Gel as Ion Exchanger in Separation of Lead (Pb-212)–Bismuth (Bi-212)–Thallium (Tl-208) (thesis)). Wolfgang Bannasch (Kernforschungszentrum. Institut für Radiochemie, Karlsruhe, Germany). May 1964. 99p.

The fixation processes of ions from aqueous solutions on silica gel were investigated for the following cations: Na^+, K^+, Cs^+(^{137}Cs), Tl^+/Tl^{3+}(^{204}Tl), Rb^{2+}(^{212}Rb), and Bi^{3+}(^{212}Bi or ^{210}Bi). As anions CrO_4^{2-}(^{51}Cr) and I^-(^{131}I) were chosen. The investigations were carried out with carrier-containing as well as carrier-free radioisotopes. For characterization of the silica gel a titration curve was obtained. The isoelectric point (IEP) of the silica gel could be determined at pH 3 by extrapolation. At pH values <IEP the silica gel showed an exchange interaction with anions. For pH values >IEP the silica gel showed the behavior of a cation exchanger. By comparison of Bi^{3+}, Pb^{2+}, and Tl^+ ions it could be shown that, not only hydroxy complexes, but also cation acetate complexes, influence the fixation processes on silica gel. Kinetic studies led to the same results for all ions: during the first minutes of contact time exchange equilibrium was achieved. By a suitable choice of pH conditions the separation of ^{212}Pb and ^{208}Te from ^{212}Bi and of ^{208}Tl from ^{212}Bi was achieved. (M.C.G.)

41563 (ORNL-P-279) VOLATILIZATION OF URANIUM AS THE HEXAFLUORIDE FROM DROPS OF MOLTEN FLUORIDE SALT. Nearly Complete Volatilization of Uranium from Molten Fluoride Salt Droplets 100 μ in Diameter is Possible with a 3-sec Exposure to Fluorine at 600°C. J. C. Mailen (Oak Ridge National Lab., Tenn.). [1962]. Contract [W-7405-eng-26]. 21p. (CONF-571-11)

From American Chemical Society 148th National Meeting, Chicago, Aug.-Sept. 1964.

Current fluoride volatility processes are too slow for Pu volatilization. A process was developed in which $NaF-ZrF_4-UF_4$ powder is melted to form falling droplets which are contacted with F_2. After the fluorination, the frozen salt droplets are collected in a chilled fluorocarbon pool to prevent sorption of UF_6. Experiments were made with drop diameters from 50 to 3200 μ, and the results are fitted by the correlation equation. 99.9% of the U is removed from droplets of diameter 235 μ at 700°C. The applications of the process for Pu volatilization and for U–Pu separation are discussed. (D.L.C.)

41564 (UJV-938/63) EXTRAKCE ČTYŘMOCNÉHO PLUTONIA Z KYSELEDEFICITNÍCH ROZTOKŮ DUSIČNANU URANYLU TRIBUTYLFOSFÁTEM. (The Extraction of Quadrivalent Plutonium from Acid-Deficient Solutions of Uranyl Nitrate With Tributyl Phosphate). S. Havelka and M. Beran (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1963]. 12p.

The course of the extraction of quadrivalent plutonium ($10^{-5}-10^{-6}\underline{N}$) with time was followed for a period of 180 minutes, from freshly prepared, as well as from aged acid-deficient solutions of uranyl nitrate (pH = 3.02), into 30% tributyl phosphate in kerosene, and also the course with time of the re-extraction of plutonium from the organic phase by an acid deficient solution of uranyl nitrate. Equilibrium in extraction is established in less than 2 minutes, in re-extraction in 30–40 minutes. The equilibrium constant q_{Pu} for extraction and re-extraction is the same. The extraction of plutonium from acid deficient solution was also studied after its acidification as a function of the time, which had elapsed from the preparation of the acid deficient solution to its acidification, of the time from the acidification to the beginning of the extraction and of the time of extraction. It was shown that at the concentration of Pu used the hydrolytic equilibrium upon alkalization and acidification is established in a time shorter than 5 minutes. The value of the distribution coefficient for Pu(IV) was measured as a function of the $UO_2(NO_3)_2$ concentration and the magnitude of the acid deficiency. At a pH greater than 2.5 q_{Pu} falls to the order of 10^{-3}. (TTT)

41565 (UJV-945/63) ÚČINKY IONIZAČNÍHO ZÁŘENÍ NA EXTRAHOVADIA–KETONY. I. ČÁST. VLIV ZÁŘENÍ NA EXTRAKČNÍ PROCES A EXTRAHEVADLA. (The Effects of Ionizing Radiation on Extractants–Ketones. Part I. The Influence of Radiation on the Extraction Process and Extractants). Jiří Teplý and Iger Janovský (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1961]. 36p.

This work is compiled concerning the influence of radiation on the extraction process and on extractants. It contains a general analysis of the problems and data on the doses of radiation to be encountered in extraction processing of exhausted nuclear fuel. Results are introduced of radiation chemical studies in aqueous solutions of U and Pu, and of studies of the radiation stability of tributyl phosphate and other extractants. Also a summary of the effects of radiation damage of tributyl phosphate on the extraction of U and Pu and of fission products is given. This literature survey contains information on the radiation dose to be expected from processing several different types of fuel and on the radiation effects on distribution coefficients and decontamination factors. While most of the article is devoted to tributyl phosphate systems, some data are also given on other phosphates and phosphonates, and on some amines, ethers, and ketones. (TTT)

41566 (ANL-Trnas-74) COMMENTS ON THE DECONTAMINATION FACTOR IN THE REPROCESSING OF URANIUM BY VOLATILIZATION. J. Schmets (Centre d'Étude l'Énergie Nucléaire, Brussels). Translated by Rita R. Inston (Argonne National Lab., Ill.). Mar. 1964. 12p.

The possibility of being able to satisfy UF_6 reprocessing decontamination specifications using the halogenation process are summarized. The USAEC specifications are not excluded but data are lacking. It appears that the halogenation reprocessing will produce a product that meets UKAEA specifications. (J.R.D.)

41567 (ORNL-tr-175) SEPARATION OF ALKALINE EARTHS BY EDTA ON ION EXCHANGE RESINS. J. J. Bouquiaux and J. H. C. Gillard. Translated by Joe F. Allen (Oak Ridge National Lab., Tenn.), from Anal. Chim. Acta, 30: 273-?(1964). 12p.

The quantitative separation of a few mg of Sr and Ba from several g of Ca is described. The alkaline earth carbonates are dissolved in 0.1 $\underline{M}$ EDTA, fixed at pH 4.8 on an ammoniacal Dowex column, and eluted, also with 0.1 $\underline{M}$ EDTA, Ca at pH 5.25, Sr at pH 6.0, Ba at pH 9.0. The end of the Ca elution can be followed accurately by a sudden pH increase in the eluate (from 4.8 to 5.25). (auth)

41568 SEPARATION OF STRONTIUM 90 AND YTTRIUM 90 BY MEANS OF AN ANION EXCHANGE RESIN OF THE OXALIC TYPE. L. Klerkx (Université, Liege). Bull. Soc. Roy. Sci. Liege, 33: 199-205(1964). (In French)

The separation of ^{90}Sr and ^{90}Y at equilibrium can be done by simple passage of the solution on the oxalic resin Amberlite IRA-400. ^{90}Y is fixed on the resin, whereas ^{90}Sr is passed. (tr-auth)

41569 PRODUCTION OF HEAVY WATER BY THE LOW TEMPERATURE DISTILLATION OF HYDROGEN. G. C. Banikiotes, Emil Cimler, and M. C. Sze. Chem. Eng. Progr., Symp. Ser., 58: 17-25(1962).

Plant scale production of water-d_2 by hydrogen distillation at low temperature is discussed. The typical process scheme that is used to produce water-d_2 is divided into essentially two distinct parts. The first part involves the purification of the feed stream to make it suitable for extremely low temperature processing and the preliminary concentration of HD to the range 5 to 7% in hydrogen. The second part consists of four processing steps: concentration of HD from 5 to 7% to 95%; the catalytic conversion of recovered HD to D; the final concentration of D; and its oxidation to D_2O. Two typical flow-sheets, one for purifying electrolytic hydrogen and one for ammonia synthesis gas, are described. From a consideration of availability of data in respect to materials processed and materials of construction, methods of processing, design of equipment, plant safety, and overall engineering aspects, it was concluded that a plant employing fractional distillation of hydrogen as the first step in the production of water-d_2 can be designed and constructed with assurance of successful operation. (P.C.H.)

41570 Np^{237} AND Pu^{238} SEPARATION AT THE SAVANNAH RIVER PLANT. W. L. Poe, A. W. Joyce, and R. I. Martens (E. I. du Pont de Nemours & Co., Aiken, S. C.). Ind. Eng. Chem., Process Design Develop., 3: 314-22(Oct. 1964). (DPSPU-63-30-44)

Experience is described at the Savannah River plant for the separation and purification of ^{237}Np and ^{238}Pu from irradiated neptunium targets, and for the separation and purification of ^{237}Np from irradiated natural and enriched uranium. Most of the processing is by anion exchange in relatively small equipment that was installed by novel techniques in the canyons of the large radiochemical separations buildings. Separations of neptunium from uranium are accomplished by modifications to solvent extraction flowsheets. The performance of the process and equipment is given for each operation. Significant changes made to achieve excellent yields and purity of products are discussed. Characteristics of anion exchange resins that are used are correlated with process performance. (auth)

41571 AN ION EXCHANGE COLUMN FOR REMOTE OPERATION IN A RADIOCHEMICAL SEPARATIONS PLANT. V. P. Caracciolo (E. I. du Pont de Nemours & Co., Aiken, S. C.). Ind. Eng. Chem., Process Design Develop., 3: 322-7(Oct. 1964). (TID-19858)

Ion exchange columns were developed for use in a radiochemical separations process at the Savannah River plant for the recovery of ^{237}Np and the separation and recovery of ^{238}Pu. The columns that were built and put into service are 12 and 24 inches in diameter and contain 25 and 100 liters of resin, respectively. They may be operated as conventional settled beds or as agitated beds when solutions that contain finely divided solids are processed. All operations, including replacement of resin, are performed remotely without mechanical valves. Resin is charged and discharged as a free-flowing slurry in a solution having a specific gravity close to that of the resin. Flow paths are determined by a set of two weirs; air pressure is applied to either or both weirs to direct flow properly for feed, wash, elution, or resin removal. Three agitated beds in series are used to obtain good recoveries when the process solutions contain solids; airlifts are used to transfer solutions between stages. The columns have operated successfully for over two years. (auth)

41572 ION EXCHANGE PROCESS FOR THE RECOVERY OF Pu^{238} FROM IRRADIATED Np^{237}. G. A. Burney (E. I. du Pont de Nemours & Co., Aiken, S. C.). Ind. Eng. Chem., Process Design Develop., 3: 328-32(Oct. 1964). (TID-19857)

A practical process is described for the recovery of ^{238}Pu product and unconverted ^{237}Np from ^{237}Np oxide compacts irradiated in nuclear reactors at the Savannah River Plant. Three cycles of anion exchange are required to separate the Np and Pu from each other and produce nitrate solutions of each element that are relatively free of fission products and other cationic impurities. Major factors in the successful operation of the process include control of the valence states of Np and Pu, the selection of resin of controlled composition, the elimination of gassing in the ion exchange columns, and the selection of conditions for the separation of Pu from Np. Data are presented to show the influence of variables to permit selection of suitable conditions for operation of the process over a range of conditions. (auth)

41573 SEPARATION OF STRONTIUM FROM BARIUM IONS BY PAPER ELECTROCHROMATOGRAPHY. Kuan Pan, Hwasheng Chen, and Yuan-tzer Lee (National Taiwan

Univ., China). J. Chinese Chem. Soc. (Taiwan), 6: 47-54 (Sept. 15, 1959).

The migration order of strontium and barium ions in aqueous citric acid solutions was reversed and the complete separation was found to be possible by the addition of methanol, ethanol, or isopropanol. The relative velocity of strontium to barium ions increased with the increasing proportion of alcohols to aqueous solutions. Separation of these ions from each other was carried out at field strengths of 10, 20, and 37 volt/cm. At 37 volt/cm, strontium and barium ions were separated completely within 1, 2.5, and 6 hours in 80% methanol, ethanol, and isopropanol solutions, respectively. The migration distances of strontium and barium ions in these solutions were found to be 16.5, 13.2, 21, and 12 and 24 and 15 cm, respectively. The readiness for separation depended on the use of solvents and decreased in the order of methanol, ethanol, and 2-propanol. The increase in partition coefficients was attributed to the addition of alcohols. (auth)

41574 ION EXCHANGE METHOD FOR THE SEPARATION OF MsTh$_1$(Ra^{228}), MsTh$_2$(Ac^{228}), ThB(Pb^{212}) AND ThC(Bi^{212}) FROM THORIUM NITRATE. Ying-Mao Chen and Chiu-ming Wong (National Taiwan Univ., China). J. Chinese Chem. Soc. (Taiwan), 6: 55-67(Sept. 15, 1959).

Recovery and purification of radiochemically useful isotopes, ^{228}Ra, ^{228}Ac, ^{212}Pb, and ^{212}Bi, from commercially available aged thorium nitrate by ion exchange were studied. The thorium ion, after conversion to complex ions by the addition of reagents such as tartaric acid, citric acid, and ethylenediaminetetraacetic acid (EDTA), was not retained by the cation exchange resin column of Dowex 50 in Na-form but its decay products were retained. The amounts of recovery of the activities were of the following order, tartaric acid > citric acid > EDTA, for the various reagents. Using 2N HCl as an eluting solution, ^{228}Ra, ^{212}Pb, and ^{212}Bi were eluted from the column, but ^{228}Ac was left behind. The latter, however, could be eluted out when 4N HCl was used as eluting solution. When this effluent of 2N HCl was allowed to pass through another column of anion exchange resin, Amberlite IRA-400 in chloride form, ^{212}Pb and ^{212}Bi were absorbed, and only ^{228}Ra passed through without retention. Separation of ^{212}Pb and ^{212}Bi from each other was carried out by eluting with 8N HCl. By this treatment only ^{212}Pb was eluted from the column and ^{212}Bi was still retained. ^{212}Bi could be eluted from the column by means of 2N H_2SO_4. The radiochemical purity of these decay daughters was checked by following their decay curves. (auth)

41575 PAPER ELECTROCHROMATOGRAPHIC STUDIES OF SOME RADIOISOTOPES. Kuan Pan and Hwasheng Cheng (National Taiwan Univ., China). J. Chinese Chem. Soc. (Taiwan), 7: 102-13(Dec. 15, 1960).

The electromigration behavior of ^{60}Co, ^{90}Sr, ^{90}Y, ^{134}Cs, ^{144}Ce, and ^{152}Eu (+^{154}Eu) as a function of pH in 1% citric acid solution was studied. The cesium ion, which migrated toward the cathode, decreased its mobility linearly as the pH increased. The strontium ion had electromigration behavior similar to the cesium ion up to pH 5 and changed the direction of migration to the anode at pH 4.5; the cobalt and rare earth ions, having similar behavior, changed their ionic charges at pH's 2.2 to 3.2, respectively. By taking advantage of such behavior, cesium could be separated from bi- and trivalent metal ions at any pH value, whereas yttrium could be separated from strontium ions, and rare earth from cobalt ions only at low pH values. (auth)

41576 EXTRACTION OF THORIUM AND URANIUM FROM CHLORIDE SOLUTIONS BY TRI-n-BUTYL PHOSPHATE AND TRI-n-OCTYL PHOSPHINE OXIDE. Kenju Watanabe (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 1: 155-62(Aug. 1964).

The extraction of thorium and uranium chlorides by TBP and TOPO was studied. The composition of complexes extracted from the chloride solutions of low acid concentration was established by a partition study to be $UO_2Cl_2(TOPO)_2$, $UCl_4(TOPO)_2$, $ThCl_4(TOPO)_2$, and $UCl_4(TBP)_2$. The composition of the thorium complex in the TBP phase free from hydrochloric acid was revealed by an infrared study to be $ThCl_4(TBP)_4$. The extraction behavior of thorium chloride by TBP was different from that of U(IV) and Pu(IV) chloride, and the composition of the complex was presumed to be $HThCl_5(TBP)_4$ in the extraction from concentrated chloride solution containing hydrochloric acid. (auth)

41577 COUNTER-CURRENT COMPUTATION ON TRINITRATO COMPLEX OF NITROSYLRUTHENIUM IN THE PRIMARY SEPARATION PLANT OF REACTOR FUEL PROCESSING. [PART] III. Masao Takigishi (Atomic Fuel Corp., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 1: 163-71(Aug. 1964).

A mathematical treatment of the optimum flow ratio for the counter-current extraction of penta and tetra complexes of nitrosylruthenium in the primary separation plant of reactor fuel processing was developed. The optimum flow ratio is a rather simple function of the ratio of reaction rate constants and molar ratio of trinitrato complex to penta and tetra complexes. Another, and much higher, volume flow ratio for the maximum decontamination factor of penta and tetra complexes was also numerically introduced for justification of the optimum flow ratio. The significant effect of lower nitric acidities in aqueous phase on the ruthenium decontamination was considered. Calculated results from the obtained equation for the optimum flow ratio were compared with the values used in practice in the ruthenium decontamination process and showed remarkable agreement. (auth)

41578 SOLVENT EXTRACTION FOR THE PRODUCTION OF ThO_2 FOR NUCLEAR REACTORS. Shu Kaneko. Nippon Kogyo Kaishi, 77: 265-70(1961). (In Japanese)

A semi-pilot plant for the TBP solvent extraction process was constructed to study several process variables in controlling impurity content and particle sizes of ThO_2 for nuclear use. It was concluded that care should be taken to adjust the concentration of thorium as well as acidity in feed solution. High thorium and nitric acid concentration gave best results. The scrubbing stage was also important. Use of high nitric acid solution in a small ratio was necessary to obtain high purity ThO_2. A typical analysis of the purified ThO_2 was as follows: Gd, Sm, Eu, Dy, Nd, Pr, La, and Ce were less than 0.25 ppm respectively, B was less than 0.25 ppm, and Fe, Cu, Mg, and Mn were less than 2.5 ppm respectively. Particle sizes of the products could be controlled to give from <1 micron to several microns by selecting the conditions to prepare the preceding thorium oxalate precipitates. Reactor-grade ThO_2 could be obtained economically on a semi-pilot plant basis (several hundred kgs of ThO_2 per month). (auth)

41579 ESTIMATION OF ZIRCONIUM AND ITS SEPARATION FROM IRON(II) USING 4-PHENYLDAPHNETIN. B. D. Jain and H. B. Singh (Univ. of Delhi). Proc. Indian Acad. Sci., Sect. A, 59: 362-4(June 1964).

A method for the separation and gravimetric determination of zirconium in the presence of iron (II) is described. Zirconium is quantitatively precipitated on addition of 1% alcoholic solution of 4-phenyldaphnetin at pH 1.8 to 2.0, and the yellow-colored zirconium complex is ignited and zirconium estimated as oxide. Interference owing to foreign ions and ir spectrum of the complex is studied. (auth)

41580 REACTOR FUEL PROCESSING. Volume 7, No. 3. Stephen Lawroski, ed. (Argonne National Lab., Ill.). Summer 1964. $0.70(GPO) (Domestic), $0.90(GPO) (Foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC).

Progress in reactor fuel processing is reviewed under the following topics: commercial aspects of fuel processing, research and development on aqueous processing, research and development on nonaqueous processing, waste disposal, and production of uranium, thorium, and plutonium and their compounds. Separate abstracts are prepared for each topic. (N.W.R.)

For abstracts of individual sections see: 41438, 41581, 41582, 41583, and 43098.

41581 COMMERCIAL ASPECTS OF FUEL PROCESSING. Reactor Fuel Process., 7: No. 3, 157-66(1964).

Domestic and foreign fuel processing plans are discussed. Evaluation of the fast-breeder reactor fuel cycle is discussed. It is reported that the AEC has adopted a policy of limiting the use charges that reactor operators must pay on leased reactor fuel from the time it reaches commercial processing plants. Fuel-cycle costs estimated for the Jersey Central Station are summarized. The production of enriched fuel is studied from an economic standpoint. A financial summary for conceptual fabrication plant for UO_2– PuO_2 fuel is analyzed. (20 references) (N.W.R.)

41582 RESEARCH AND DEVELOPMENT ON AQUEOUS PROCESSING. Reactor Fuel Process., 7: No. 3, 167-79(1964).

Developments in aqueous fuel separation processes are reviewed. Information is included on: crushing of aluminum-clad uranium-aluminum fuel plates, dissolution of UO_2– PuO_2 fuel cores using nitric acid containing ammonium fluoride, leaching of fission products from impregnated graphite, TBP-25 Process performance, reduction of plutonium(IV) in TBP processing using uranium(IV), effect of dibutyl phosphoric acid on stripping of uranium from TBP diluent mixtures, solvent deterioration in Purex Process, design and performance of product evaporator with a large poisoned disengaging head and four large-capacity poisoned storage vessels, and design and performance of liquid-liquid centrifugal contactor for solvent extraction processes. (20 references) (N.W.R.)

41583 RESEARCH AND DEVELOPMENT ON NONAQUEOUS PROCESSING. Reactor Fuel Process., 7: No. 3, 180-99(1964).

Developments in nonaqueous fuel separation processes are reviewed. Information is included on: volatility separation processes for high- and low-enriched fuels, properties of uranium fluorides, fused-salt volatility process applied to uranium-aluminum alloy fuel, laboratory corrosion tests, engineering dissolution tests, pyrometallurgical processes, EBR-II Fuel-Cycle Facility for recovery and purification of spent fuels, melt-refining technology, purification of metals by electron-beam melting, vacuum distillation, and arc and induction zone refining, development of liquid-metal and salt separation processes, high-temperature chemical conversion processes for the recovery of fissile and fertile materials from irradiated oxide and carbide reactor fuels, and electrolytic separation processes. (54 references) (N.W.R.)

41584 CHARCOAL TRAP WITH RAPID THERMAL RESPONSE. Don O. Coffin (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 35: 1534-5(Nov. 1964). (LADC-6486)

A charcoal trap for separation of gases by selective absorption is described. Unique features claimed for the design are operation to 300°C without auxiliary heaters, rapid thermal cycling over a 500°C range, and modular construction adaptable to a wide range of capacities. (auth)

41585 ANALYTICAL CONTROL OF THE NUCLEAR FUEL REPROCESSING PROCESS. Natalija Cvjeticanin, Jovanka Obrenovic-Paligoric, and Dusanka Nemoda ("Boris Kidrich" Inst. of Nuclear Sciences, Belgrade). Tehnika (Belgrade), 18: 1997-2004(1963). (In Serbo-Croatian)

Analytical methods were developed for control of the main components for reprocessing, for uranium, free acid, plutonium, fission products, tributyl phosphate, and some corrosion products. Potentiometric and spectrophotometric methods were used in uranium determination in aqueous and organic solutions. For the highly active solutions uranium determination in the aqueous solutions was achieved by specific gravity measurement. On the basis of the obtained measurements and known sample acidity, the concentration of uranium could be calculated. The determination of free acid in solution containing hydrolyzable ions could be carried out by potentiometric titration after elimination the uranyl or hydrolyzable ions by means of cation exchangers or after their complexing. Plutonium was determined by precipitation and liquid-liquid extraction methods and by reaction counting for sub-microgram amounts. For the separation and determination of various oxidation states of plutonium different methods were used, including spectrophotometry, extraction, and reversed phase partition chromatography. Routine analysis of the fission products was limited to radiometrical measurements of gross β-γ and α activity. Chemical separation methods were used for special determinations. The tributyl phosphate content in kerosene solution could be estimated by saturation with nitric acid and by the uranium saturated method. Paper chromatography proved to be one of the methods by which the degradation products of tributyl phosphate can be determined. Some results obtained in the control of the liquid-liquid extraction of uranium in a small scale facility of the Institute for Nuclear Science (Boris Kidrič) are given. (auth)

41586 EXTRACTION OF LANTHANIDES BY THENOYLTRIFLUOROACETONE AND ITS MIXTURE WITH TBP. G. V. Korpusov, G. V. Tsygankova, and E. G. Goryacheva. Tsvetn. Metal., No. 7, 63-4(July 1964). (In Russian)

Distribution of rare earths during extraction by thenoyltrifluoroacetone-benzene solutions was studied as a function of pH and aqueous phase composition. The experiments carried out with 0.5 M TTA-benzene solutions with small additions of TBP and aqueous nitrate solutions of ^{140}La, ^{152}Eu, ^{154}Eu, ^{159}Gd, ^{90}Y, and ^{175}Yb showed that small additions of TBP sharply increased the rare earth distribution coefficients. (R.V.J.)

41587 EXTRACTION PURIFICATION OF BERYLLIUM USING ALKYLORTHOPHOSPHATES. A. M. Semenikhin and B. V. Gromov (Moscow Chemical Technological Inst.). Zh. Neorgan. Khim., 9: 1272-9(May 1964). (In Russian)

Studies of Be, Al, and Fe^{2+} extraction from sulfuric and hydrochloric acids by mono- and dialkylorthophosphoric acid showed that complete extraction can be achieved in weakly basic (pH 7 to 8) media. An increase in acidity reduced the extraction of Be. Separation of the Be, Al, and Fe^{2+} in weak basic media was not possible, but additions of Trilon B resulted in Be and Al separation. Without Trilon B, the separation of Be, Al, and Fe^{2+} may be carried out efficiently in a 10 g/l H_2SO_4 medium. Purification factors for Be from Al under these conditions are 7 to 8 and for Fe^{2+}, 15 to 20. Repeated extractions of Be, Al, and Fe^{2+} using various concentrations of sulfuric and hydrochloric acids indicated that $5\underline{N}$ HCl is the best medium. (R.V.J.)

41588 DETERMINATION OF THE SIZE OF SOLVATE MOLECULES FORMED BY TRIBUTYLPHOSPHATE. A. V. Nikolaev, Yu. A. Afanas'ev, V. B. Durasov, and A. I. Ryabinin (Inst. of Inorganic Chemistry, Novosibersk, USSR). Zh. Strukt. Khim., 5: 490-2(May 1964). (In Russian)

Sizes of some solvate molecules formed by TBP were calculated using the formula for molecular radius: $r = kT/6\pi D\eta$ (where k is Boltzmann constant, T is absolute temperature, D is diffusion constant, and η is viscosity). Radii are tabulated for $UO_2(NO_3)_2$, $Ce(NO_3)_4$, $Th(NO_3)_4$, and HNO_3 in TBP. (R.V.J.)

41589 MULTI-STAGE CENTRIFUGAL CONTACTOR (Engineering Materials). (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). (CAPE-1154)

Drawings (44) are presented for a six-stage contactor that processes natural or enriched uranium solutions by solvent extraction. The stages are 10 in. in diameter. High mass-transfer rates are obtained at total flow rates of at least 40 and 60 gpm, respectively. Flows of organic solvent and aqueous feeds are countercurrent between stages, but are in phase within a stage. The hydraulic capacity is in excess of 60 gpm with undiluted tri-$\underline{n}$-butyl phosphate as the solvent, provided the aqueous phase contains at least $3\underline{M}$ HNO_3. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

ENGINEERING

General

41590 (AEDC-TDR-64-105) BASIC PROCESSES OF ION BEAM TERMINATION. J. D. Trolinger, J. I. Shipp, and A. E. Lennert (Arnold Engineering Development Center, Tullahoma, Tenn.). May 1964. Contract AF(600)-1000. 85p.

Theoretical and empirical information necessary for the design of an electrical propulsion test facility collector system complex is compiled. Design considerations, which include sputtering, beam accommodation, secondary emission, and less serious secondary effects, are considered in some detail. A theoretical model is presented, which accounts for the energy dependence of the sputtering phenomena first at low ion energies and second in the region where the Bohr screening parameter is of the order of unity. Based on these functions obtained from the theoretical model in the two regions, an asymptotic empirical relation for the sputtering ratio as a function of ion energy is found to give a satisfactory account of available data. In addition, equations are developed to evaluate the effects of sputtered particles upon vacuum chamber pressure, the amount of flux leaving the target that returns to the engine, and the time required for the target to become saturated with beam particles. Two different collectors, the solid metallic type and a liquid metal system, are evaluated. The advantages and limitations of each are discussed. (auth)

41591 (LA-DC-6573) COMPATIBILITY TESTING OF ADHESIVES. F. W. DuBois (Los Alamos Scientific Lab., N. Mex.). July 15, 1964. Contract W-7405-eng-36. 45p. (CONF-695-2)

From EIVR-10 Atomic Weapons Research Establishment Meeting, Aldermaston, Berks, Eng., Oct. 1964.

A discussion is given of the compatibility testing of explosives with adhesives. A recently completed autoignition experiment and a long-term aging experiment that is in progress are reported. Descriptions of compatibility tests in current use at LASL and some pertinent results are included. (auth)

41592 ELECTRIC PROPULSION CHARACTERISTICS OF A PULSED PLASMA RAIL ACCELERATOR. Daniel H. Winicur (Hughes Aircraft Co., El Segundo, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1673-5(Sept. 1964).

The results are presented of an analog computer study of the propulsion characteristics of a pulsed plasma rail accelerator in which the plasma moves as a slug. (D.C.W.)

41593 IMPROVEMENTS IN OR RELATING TO PACKAGE IRRADIATION PLANT. Sidney Jefferson (to United Kingdom Atomic Energy Authority). British Patent 970,074. Sept. 16, 1964. Filed Jan. 19, 1962.

A labyrinth in a biological shielding for a package irradiation plant is designed in which radiation scattering from one section of the labyrinth to another is minimized. In the labyrinth, a radiation shielding mass in the shape of a right cylinder is located at a right angle junction between two consecutive passages in the labyrinth, and a short length of monorail is rotatably mounted on a spindle above the cylinder for transferring packages from one passage to the other. (D.L.C.)

Applications of Nuclear Explosions

41594 (UCRL-7634) ENGINEERING APPLICATIONS OF NUCLEAR EXPLOSIVES: PROJECT PLOWSHARE. Gerald W. Johnson and Gary H. Higgins (California. Univ., Livermore. Lawrence Radiation Lab.). May 19, 1964. Contract W-7405-eng-48. 49p.

Exploration of possible engineering uses of nuclear explosives begun in 1957 has continued and substantial progress has resulted. Major advances have been achieved in development of much cleaner explosives that will extend the range of possible use and lead to lower costs. Several nuclear experiments have been carried out which provide and improved technological base from which to assess both cost and feasibility of various projects. The effect of the additional knowledge has been to increase the confidence in the feasibility and economic advantage of nuclear excavation, certain underground mining applications, and isotope production for research. (auth)

Facilities and Equipment

Refer also to abstracts 41219 and 41985.

41595 (LA-DC-6394) THE LOS ALAMOS "WING 9" ALPHA-GAMMA BOX SYSTEM. C. C. Burwell, J. W. Schulte, and M. T. Wilson (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract [W-7405-eng-36]. 14p. (CONF-654-2)

For presentation at American Nuclear Society Meeting, San Francisco, Nov.-Dec., 1964.

A description is given of the alpha-gamma box system and its associated standard accessories used in the Los Alamos "Wing 9" Hot Cell Facility. Equipment for specialized cell functions is not described. The box shape, material, illumination, and access parts are discussed from the standpoint of ease of manipulation, utilization of cell space, viewing, and decontamination. The manipulator booting system in use facilitates remote replacement and full cell manipulator coverage with a minimum of interference with viewing. The air handling system emphasizes a small volume high pressure exhauster with a totally sealed box to permit small filter and piping sizes. Standard box accessories include 7- and 18-in. transfer mechanisms and a 5-in. air lock for material transfers, an in-box hoist, a liquids-solids vacuum cleaner, a shielded storage vault, replaceable shelving, and an intercommunication system. (auth)

41596 (NP-14344) VYBOV MATERIALA ELEKTRODOV ELEKTROSTATICHESKIKH SEPARATOROV. (Selection of Material for Electrodes of Electrostatic Separators). V. A. Ergakov and I. I. Kryuchkov (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 6p.

The breakdown strength of the gap between the electrodes depending on the kind of residual gas (argon, hydrogen, nitrogen, helium) and on the materials of electrodes (stainless steel, chrome, copper, nickel, brass, silver, duraluminum, aluminum) was tested experimentally. It is shown that chrome plated or duraluminum electrodes are preferable for electrostatic separators and helium under pressure (1.5 to 5) × 10^{-3} Hg as a residual gas. (auth)

41597 (SLAC-Trans-7) A SOLENOID WITH A UNIFORM MAGNETIC FIELD. S. P. Kapitsa. Translated for Stanford Univ., Calif., from p.109-18 of "Elektronika Bol'shikhmoshchnostei" (a publication of the Publishing House of the Academy of Sciences, USSR, Moscow, 1963). 15p.

An analysis and description of a solenoid, which creates a uniform magnetic field around the greatest part of its length, are given. The winding of the solenoid has a constant diameter and is assembled from sections with varying current density. The field constancy in the described construction attains ± 0.07% and is determined by the accuracy of preparation of the windings. An effective system for cooling the windings is proposed. The given system of winding makes it possible to obtain magnetic fields of several tens of kilo-Oersteds. (auth)

41598 ORGANIZATION AND PERFORMANCE OF WORK AT RADIOISOTOPE LABORATORIES. P. I. Moiseitsev. Gigiena i Sanit., 29: No. 6, 64-7(June 1964). (In Russian)

Various safety measures and practical suggestions are given for the design, equipment, and furniture for radioisotope laboratories. Rules and regulations are also given for personnel handling radioactive materials. (R.V.J.)

41599 THE PERFORMANCE OF A CROSSED-FIELD MAGNETO-AERODYNAMIC ACCELERATOR. R. M. Krupka (Continental Can Co., Chicago) and S. P. Kezios. J. Appl. Mech., 31: 409-18(Sept. 1964).

A one-dimensional theory of the performance of a crossed-field, magneto-aerodynamic accelerator is presented and the results are summarized in the form of design charts. With the aid of these charts, the synthesis characteristics of engineering applications may readily be accomplished, utilizing graphical construction techniques. Design charts are available that cover a range of initial Mach numbers of 0.1 to 0.9 in intervals of 0.1, and 2 to 10 in intervals of 1. Design charts for initial Mach numbers of 0.5 and 2 are presented, and their utility is demonstrated with reference to several numerical examples. (auth)

41600 THE OPTIMIZATION OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS OR CONCRETES. K. Preiss and P. J. Grant (Imperial Coll. of Science and Tech., London). J. Sci. Instr., 41: 548-51 (Sept. 1964).

It is shown how the use of a cadmium cover over the detector in a neutron scattering water content gage eliminates the undesired influence of the chemistry of the soil or concrete on the reading. Equations relating time of count to error in water density are derived and used to determine the optimum distance between source and detector, which is found to be 7 cm from center to center. (auth)

41601 HOT LABORATORY OF THE "BORIS KIDRIČ" INSTITUTE OF NUCLEAR SCIENCES AT VINČA. Zdenko Dizdar (Boris Kidrich Inst. of Nuclear Sciences, Vinca, Yugoslavia). Nukl. Enerija, 1: 7-9(July 1964). (In Yugoslavian)

Reasons for building the Hot Laboratory at the Boris Kidrič Institute at Vinča are given and its characteristics and program are presented. The program covers the production and application of radioactive isotopes, fuel reprocessing, research in the chemistry of actinide elements, and analysis of radioactive materials. The Laboratory has already well established connections with many industrial and research organizations in the country that are using radioactive isotopes. Through the reprocessing of fuel it is liable to play a vital part in the development of nuclear power in Yugoslavia. (auth)

41602 THE KALNA URANIUM ORE PROCESSING PLANT. Bela Bunji (Establishment for Nuclear Raw Materials, Belgrade). Nukl. Enerija, 1: 10-14(July 1964). (In Yugoslavian)

The chemistry of carbonate-bicarbonate leaching of ore from the deposit at Gabrovnica (Stara Planina) is described. The conditions of work have been stated under which the processing takes place are stated. An explanation is given in regard to the process of precipitation by way of catalytic reduction. A short description is also given of the location and layout of the experimental ore processing plant, as well as a description of some of the main characteristics of the facility, the conditions of work, control of the process, and the results. Examples are presented of experimental heap leaching and leaching in situ. (auth)

41603 HIGH-TEST PRESSURIZED FILAMENT AND MELTING POINT FURNACES (Engineering Materials). (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (CAPE-1128)

Drawings (3) of the furnaces, which are used to determine melting points for solid ceramic materials such as UO_2-PuO_2, are presented. The pressurized furnace is designed for a working pressure of 1500 psi and a working temperature of 500°F. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

41604 MOLTEN SALT PUMPS–DANA (Engineering Materials). (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). (CAPE-1066)

Drawings (49) are presented for sump-type centrifugal pumps used in the Aircraft Reactor Experiment. The capacity of the pumps is 150 gpm with a head of 300 ft at 3750 rpm. The fluid pumping power is 8.7 and 23 hp for NaK and $LiF-BeF_2-UF_4$, respectively, at 1200°F. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

41605 FORCE TRANSMITTING SEAL (Engineering Materials). (Dow Chemical Co. Rocky Flats Plant, Denver). (CAPE-1113)

Two drawings of a seal used for transmitting a force such as that from a density balance through a dry box are included. Directions are given for using the seal with a Toledo scale. Individual titles are presented in the Engineering Materials List (TID-4100). (D.C.W.)

41606 AN AUTOMATIC DEVICE FOR THE CONTROL OF FLOCCULATION AND SETTLING RATES IN MILL THICKENERS. Willard M. Johnson (Atlas Minerals, Moab, Utah). 12p. (CONF-656-3)

From 9th Annual Minerals Symposium, Moab, Utah, May 1964.

A device that is designed to vary the feed rate of the flocculent continuously as flocculent requirements vary in mill thickeners is described. Several unpredicted problems encountered in the development of an effective flocculent control system are discussed along with the operation and performance of the device. (P.C.H.)

41607 IMPROVEMENTS IN OR RELATING TO ACCESSORY-CARRYING MEMBERS FOR RADIATION-

PROTECTIVE SCREENS AND RADIATION-PROTECTIVE SCREENS EMBODYING SAME. Jean Savouyaud and Jean Vertut (to Commissariat à l'Energie Atomique). British Patent 969,897. Sept. 16, 1964. Priority date Jan. 14, 1960, France.

An accessory-carrying member for mounting in a radiation-protective screen is designed which enables the accessory to be replaced easily without affecting the radiation protection. The member has a circular transverse opening which is helically threaded to receive an accessory to form a radiation-tight joint. The member comprises a plurality of interfitting submembers whose mutual joining surfaces prevent radiation from passing through. Two embodiments of the member are described. (D.L.C.)

41608 MECHANICAL MANIPULATORS FOR THE DISPLACEMENT OF OBJECTS IN A RADIOACTIVE MEDIUM. Rene Le Guennec and Pierre Pesenti (to Commissariat à l'Energie Atomique). British Patent 969,899. Sept. 16, 1964. Priority date Feb. 25, 1960, France.

A mechanical manipulator comprising a pilot member and a controlled member disposed on opposite sides of a wall of an enclosure is designed which facilitates the sealing of the enclosure. The manipulator includes two articulated parallelograms connected at one corner by concentric tubes which run through the wall of the enclosure. The number of concentric tubes is proportional to the number of movements to be transmitted from the pilot member to the controlled member, and the transmission through the wall is effected by rotation of the tubes. (D.L.C.)

41609 IMPROVEMENTS IN OR RELATING TO CONVEYOR SYSTEMS. Sidney Jefferson (to United Kingdom Atomic Energy Authority). British Patent 970,164. Sept. 16, 1964. Filed Apr. 27, 1961.

A conveyor system is designed for moving packages past a gamma source in an irradiation plant. The system comprises a structure suspended vertically on a trolley, openable and closeable package-retaining means at the lower end of the structure, and fulcrum pins on the trolley for rotating the structure into a horizontal position for package loading and into a vertical position for transit. The advantage of the system is that the clearance space between adjacent carriers can be minimized. (D.L.C.)

41610 IMPROVEMENTS RELATING TO GRIPPING MEANS FOR PERFORMING REMOTE CONTROLLED GRIPPING OF LOADS, ESPECIALLY RADIOACTIVE LOADS. (to Commissariat à l'Energie Atomique). French Patent 1,337,489. Aug. 5, 1963. Filed Aug. 3, 1962.

For the handling of a container for radioactive waste a gripping device, adapted to be lowered over such a container, was developed. Radially movable lockets of the device may cooperate with an inwardly turned edge of the container. A hollow electromagnet works together with its movable core linked to the lockets by a system of pivotally mounted levers. The core movement provoked by excitation of the electromagnet against the action of a return spring controls the simultaneous withdrawal movement lockets. (IIB)

Heat Transfer and Fluid Flow

Refer also to abstracts 42881 and 42971.

41611 (AEEW-R-358) BURN-OUT ANALYSIS. PART 5. EXAMINATION OF PUBLISHED WORLD DATA FOR ROD BUNDLES. Robert V. Macbeth (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). June 1964. 99p.

Burn-out data and descriptive details of 24 different rod bundle geometries have been compiled and subjected to analysis. The majority are at about 1,000 psia and the conclusions reached refer mainly to this pressure with forced convection and with liquid water inlet. The most important conclusion is that details of the internal structure of a bundle in general have no effect on burn-out, and this is substantiated by a wide variety of rod supports and spacers used. The only important cross-sectional geometry parameter has been identified as the heated equivalent diameter (4 × flow area/heated perimeter). Another important conclusion is that due to gravity, the burn-out flux in horizontal rod bundles can be as much as 50% below that for similar vertical bundles with upflow. A further drop in burn-out flux may also occur in horizontal channels due to severe flow stratification. A local conditions type of burn-out equation is presented which predicts 97% of the 1,000 psia data to within ±12%. The equation has been used to examine the optimization of rod diameter and number of rods in a bundle to give maximum power output. (auth)

41612 (EURAEC-1128) THE PHENOMENA ACCOMPANYING THE COMMENCEMENT OF FLOW INSTABILITY IN VERTICAL BOILING CHANNELS. Special Technical Report No. 13. C. L. Spigt, F. J. M. Dijkman, and M. Bogaardt (Eindhoven, Netherlands, Technische Hogeschool). Feb. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 032-60-11-RDH. 14p. (CONF-675-1)

From 8th Meeting on Hydraulics, June 1964.

Results are presented of an experimental study of the appearance of hydrodynamic instabilities in a vertical boiling channel. An effort has been made to determine accurately the commencement of the instabilities by utilizing autocorrelations and power spectra. The character of the instabilities has been examined by vacuum fraction detectors placed at different heights by impedance measurement. The appearance of instabilities is presented in function of the pressure and sub-cooling at the inlet of the channel. (auth)

41613 (GEAP-4571) HEAT TRANSFER IN AN ANNULUS WITH VARIABLE CIRCUMFERENTIAL HEAT FLUX. W. A. Sutherland and W. M. Kays (General Electric Co., Atomic Power Equipment Dept., San Jose, Calif.). May 1964. Contract AT(04-3)-789. 34p.

An analysis of heat transfer in a concentric circular tube annulus with an arbitrarily prescribed heat flux around the periphery of either wall, or both walls, is presented. Solutions have been obtained for the hydrodynamically and thermally fully developed condition for constant heat rate per unit of tube length, for both the laminar and turbulent flow regimes. With these results, the ensuing temperature variation around either wall may be predicted. Contrary to what might be expected, the wall temperature variation is very substantial in turbulent as well as laminar flow. An example shows the importance of this effect. (auth)

41614 (GEAP-4616) TWO-PHASE PRESSURE DROP IN STRAIGHT PIPES AND CHANNELS; WATER-STEAM MIXTURES AT 600 to 1400 PSIA. E. Janssen and J. A. Kervinen (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). May 1964. Contract AT(04-3)-189. 135p.

Tests were run to determine the adiabatic two-phase pressure drop for upward, downward, and horizontal flows in several pipes and rectangular channels. The steam–water mixtures were used at flow rates of 0.25×10^6 to 2.0×10^6 lb/hr-ft^2 and qualities of 0 to 0.9. High-speed movies and steam-void measurements were carried out in one channel. The results are compared with predictions. (D.L.C.)

41615 (GEAP-4622) TWO-PHASE PRESSURE DROP ACROSS CONTRACTIONS AND EXPANSIONS; WATER–STEAM MIXTURES AT 600 TO 1400 PSIA. E. Janssen and J. A. Kervinen (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). June 1964. Contract AT(04-3)-189. 65p.

The two-phase pressure loss was measured across various two-dimensional and circular contraction and expansion geometries for steam–water at 600 to 1400 psia, flow rates from 0.25×10^6 to 2.0×10^6 lb/hr-ft^2, and qualities from 0 to 90 percent. A study was made of the flow pattern in the vicinity of the contraction-expansion inserts. The flow pattern study shows a strong mixing as the flow contracts, and the formation of a vena contracta just past the contraction inlet. The vena contracta area is smaller for long contraction-expansion inserts than for short ones. Equations based on a single momentum model, with the slip ratio S a function of local mass velocity for short inserts, and S = 1 at the vena contracta for long inserts, predict values for the pressure change past contractions and expansions which are in good agreement with measured values. The agreement could be improved slightly at flows less than 1×10^6 lb/hr-ft^2, and qualities greater than 30 percent, by assuming either a larger area or a smaller value for the void fraction α at the vena contracta. The good agreement is unaffected by flow orientation, or by pressure in the range of 600 to 1400 psia. (auth)

41616 (TID-21151) THE NEAREST-NEIGHBOR HYDRODYNAMICS CALCULATION. Harwood G. Kolsky (Los Alamos Scientific Lab., N. Mex.). July 1, 1961. Contract W-7405-eng-36. 36p. (LAS-L-T-5)

The equations for mechanical and thermodynamic quantities for hydrodynamics calculations in which the regular space mesh array is abandoned and for which each point retains its neighbors throughout the calculation are presented in revised form for free-point calculations. A method of selecting the neighboring points to be used and formulas to use them to formulate the spatial derivatives at each point is presented. (R.E.U.)

41617 (ANL-Trans-61) VOID FRACTION AND SLIP IN TWO-PHASE UPWARD AND DOWNWARD FLOW. R. Deraux (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble). Translated by M. Patricial Sughroe (Argonne National Lab., Ill.), from Note TT-165. Apr. 1964. 21p.

The experimental procedure is described and the method of void fraction measurement is shown. Error analyses show that the precision of the results is acceptable for high void fraction ($\Delta\alpha/\alpha \simeq 5\%$) but mediocre for low void fraction ($\Delta\alpha/\alpha \simeq 25$ to 30%). The curves (void, superficial gas velocity), with superficial liquid velocity as a parameter, are compared with those of other investigators and appear to show that the true gas velocity is approximately constant at low water rates in the bubbly flow system. The curves of slip as a function of void are drawn for upward and downward flows and show that the slip is, in general, not unity. (auth)

41618 ON THE CONTACT THERMAL RESISTANCE IN FUEL ELEMENTS. V. S. Miller. Akad. Nauk Ukr. SSR, Inst. Teploenerg. Ab. Prats, 133-9(1962). (In Ukrainian)

The performance of fuel elements was analyzed, and the effects of various factors on the contract heat transfer between the element core and cladding were studied. (R.V.J.)

41619 GENERAL SOLUTION OF THE EQUATIONS OF PARALLEL-FLOW MULTICHANNEL HEAT EXCHANGERS. Jerzy Wolf (Instytut Lotnictwa, Warsaw). Intern. J. Heat Mass Transfer, 7: 901-19(Apr. 1964).

A general solution of the systems of differential equations describing the distribution of temperature and temperature difference of fluids in exchanger channels is presented. It was found that for n channels the number of equations is at most n or n−1. Solutions are given in a form enabling introduction of the boundary conditions. These solutions were obtained in the general case of channels forming a bundle and exchanging heat according to the principle of the maximum possible number of heat exchanges between channels and in most common practical cases in which the number of heat exchanges is reduced. (auth)

41620 THE HEAT TRANSFER BETWEEN METALLIC SURFACES IN CONTACT. M. von Kiss (Eidgenossiche Technische Hochschule, Würenlingen, Switzerland). Neue Tech., 5: 714-24(Dec. 1963). (In German) (EIR-47)

Experimental results from the literature for thermal contact conductances are graphically presented for steel–steel, aluminum–aluminum, aluminum–uranium, and aluminum–steel surface combinations. By correlation and augmentation of previous theoretical work, a calculation method was established for determining the temperature difference between contacting metallic surfaces for given heat flux and contact pressure. The resulting equation is: $q = [\alpha(\lambda/\lambda_0)(H_0/H\, p/p_0)^\beta + \lambda_g/b(\delta_1 + \delta_2)]\, \Delta T$. The exponent β of the contact pressure was determined from theoretical considerations as a function of surface roughness in such a way that, for a particular surface roughness range, agreement with the average of measured β values was obtained. The constant α depends only on the nature of the surface and can be determined by measurement for one particular contact pressure and material for each grade of surface. Thus the equation can be used to correlate results for other materials and other contact pressures. (auth)

41621 ASYMPTOTIC SOLUTION OF THE BOLTZMANN-KROOK EQUATION FOR THE RAYLEIGH SHEAR FLOW PROBLEM. Leon Trilling (Massachusetts Inst. of Tech., Cambridge and Université, Paris). Phys. Fluids, 7: 1681-91(Oct. 1964).

An asymptotic solution of the Boltzmann-Krook equation is constructed for the Rayleigh shear flow problem. The distribution function is expanded in powers of the square root of the inverse Knudsen number assumed small. If it is required to satisfy boundary conditions on the averaged flow parameters, the first term of the expansion yields a term identical with the solution of the Navier-Stokes equation with no-slip condition; subsequent terms yield slip and satisfy a sequence of linear equations whose coefficients are determined by the no-slip Navier-Stokes solution. If the boundary condition is specified on the distribution function, there is in addition a molecular sublayer whose thickness is of the order of the mean free path. (auth)

41622 A STUDY OF SATURATED POOL BOILING POTASSIUM UP TO BURNOUT HEAT FLUXES. Charles Phillip Colver. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1963. 141p.

Potassium pool boiling from the outer surface of a horizontal $^3/_8$-in. diameter by 1.25-in. Haynes-25 tube was studied at heat fluxes up to and including burnout. Measurements of heat flux and the temperature difference between the boiling surface and liquid saturation temperature were made for ten nucleate boiling potassium runs in the pressure range 1 to 45 psia. The data possessed considerable scatter; however, mean wall superheats were in the order of 20°F for heat fluxes over 100,000 Btu/(hr)(sq ft). Burnout heat flux determinations were made by two methods using four boiling tube assemblies in the pressure range 0.15 to 22 psia. The first method involved holding the heat flux constant and gradually decreasing the pressure, while in the other method the pressure was maintained constant and the heat flux increased. Burnout was indicated in either method by an instantaneous temperature rise measured by thermocouples inserted in the boiling tube wall. An empirical fit of the burnout results can be represented by the following equation: $(q/A)_{bo} = 4 \times 10^{5} p^{0.167}$, where $(q/A)_{bo}$ is expressed in Btu/(hr)(sq ft) and the saturation pressure, p, in psia. Pronounced temperature fluctuations between 10 and 150°F existed in the heat transfer surface during the boiling of potassium. Below 250,000 Btu/(hr)(sq ft) temperature fluctuations were common in the bulk liquid and were accompanied with noticeable pressure fluctuations. (Dissertation Abstr., 25: No. 1, 1964)

41623 MAXIMUM FLOW RATE OF A SINGLE COMPONENT, TWO-PHASE MIXTURE. F. J. Moody (General Electric Co., San Jose, Calif.). New York, American Society of Mechanical Engineers, 1964, Paper No. 64-HT-35, 8p. $1.00. (CONF-644-16)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

A theoretical model was developed for predicting the maximum flow rate of a single component, two-phase mixture. It is based upon annular flow, uniform linear velocities of each phase, and equilibrium between liquid and vapor. Flow rate is maximized with respect to local slip ratio and static pressure for known stagnation conditions. Graphs are presented giving maximum steam/water flow rates for: local static pressures between 25 and 3000 psia, with local qualities from 0.01 to 1.00; local stagnation pressures and enthalpies that cover the range of saturation states. (auth)

41624 EFFECT OF LARGE TEMPERATURE GRADIENTS ON CONVECTIVE HEAT TRANSFER: THE DOWNSTREAM REGION. D. M. McEligot, P. M. Magee, and G. Leppert (Stanford Univ., Calif.). Metals Park, Ohio, American Society for Metals, 1964, Paper No. 64-HT-12, 7p. $1.00. (CONF-644-18)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

The results of an experimental investigation of the frictional and heat transfer effects in air, nitrogen, and helium in steady, turbulent flow in round tubes are presented. Wall-to-bulk temperature ratios extend from near unity to 2.5, entering Reynolds numbers from 15,000 to 233,000. Dependence of the thermodynamic and transport properties on temperature is shown to be significant in both heat transfer and wall friction and is reflected in the empirical correlations for local and average coefficients that are developed. The results of others who have analyzed or measured variable properties effects were recalculated where necessary to facilitate comparisons. (auth)

Materials Testing

Refer also to abstract 41887.

41625 (ANL-6846) A SUMMARY REPORT ON NEUTRON RADIOGRAPHY. Harold Berger (Argonne National Lab., Ill.). July 1964. Contract W-31-109-eng-38. 28p.

The neutron radiography program at ANL is summarized. Methods and instruments used for recording neutron images are described; photographic detection methods are considered. Neutron sources used for radiographic inspection are described. Some applications of neutron radiography in irradiated fuel inspection and in reactor control materials inspection are discussed. (R.E.U.)

41626 (HW-81957) THIN WALL TUBING TESTS USING ULTRASONIC SHEAR WAVES. PART II. PRODUCTION TEST EQUIPMENT, ITS OPERATION AND TEST RESULTS. M. F. Zeutschel and N. E. Dixon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 30, 1964. Contract AT(45-1)-1350. 62p.

A testing system with compatible electronic and mechanical portions was developed. With this system, two separate ultrasonic tests are performed simultaneously to detect axially and circumferentially oriented defects, respectively. Defects as small as 1 mil deep by 15 mils long and as large as halfway through the wall can be detected, and 11 inches of tubing are inspected per minute. The system was used to test tubing of several diameters, thicknesses, and materials. Good correlation was obtained between the defect depth and the ultrasonic amplitude at which it was detected, and the test is insensitive to defect orientation. (D.L.C.)

41627 (TID-21011) STUDIES OF THE FATIGUE STRENGTH OF PRESSURE VESSELS. (1) CYCLIC PRESSURE TEST OF LARGE SIZE PRESSURE VESSELS. (2) LOW CYCLE FATIGUE TESTING OF ONE-HALF SCALE MODELS PRESSURE VESSELS. (3) EFFECT OF WELD DEFECTS ON THE FATIGUE STRENGTH OF A302B STEEL. Progress Report No. 9. A. G. Pickett, W. R. Schmidt, and S. C. Grigory (Southwest Research Inst., San Antonio). July 20, 1964. Contract AT(11-1)-1228. 36p.

Results of cyclic pressure tests on the plastic fatigue strength of large pressure vessels, tests of size effects on the fatigue strength of large pressure vessels, and weld defect fatigue tests on A302B steel for pressure vessels are presented. (N.W.R.)

41628 DOUBLE FREQUENCY EDDY CURRENT INSTRUMENT FOR NUCLEAR FUEL CLAD TUBING INSPECTION. Kunio Ono (Hitachi Research Lab., Ltd., Japan). Nippon Genshiryoku Gakkaishi, 6: 447-54(Aug. 1964). (In Japanese)

A double frequency eddy current in nondestructive testing instrument, which makes it possible to estimate the depths and the radial locations of defects in tube walls, was developed for use in the inspection of fuel clad tubing. The two frequencies are chosen in such a way that lower ones give a larger penetration depth, while higher ones give a less penetration depth of eddy currents than the tube wall thickness. The instrument has two channel pulse generators, from which lower and higher frequency damped oscillatory pulses are alternately supplied to the same driving coil that encircles a test object, and detected signals from a differential pickup coil are divided again to the low frequency and high frequency signals by time gate circuits. Experiments were conducted using aluminum tubes and the depths and the radial locations of defects in tube walls were proved to be estimated by the ratios of the amplitudes of the low frequency detected signals and high frequency ones. (auth)

Protective Structures

41629 (AD-412342) PLANNING GUIDES FOR DUAL-PURPOSE SHELTERS. Robert W. Smith and Mary Ann Lasky (American Inst. for Research, Pittsburgh). July 31, 1963. Contract OCD-OS-62-104. 161p. (AIR-C-93-7/63-TR)

The factors considered in planning and developing group shelters within existing structures or in designing buildings as shelters are discussed. Radiological protection, blast and thermal-radiation protection, maintenance of shelter and facilities, temperature and atmosphere control, water and food supplies, lighting, fire protection, medical facilities, sanitation, communications, and shelter organization are discussed. (R.E.U.)

Vacuum Engineering

Refer also to abstract 41952.

41630 EXTREME HIGH VACUUM. Milo P. Hnilicka and Karl A. Geiger (National Research Corp., Cambridge, Mass.). Ind. Res., 36-45(Sept. 1964).

Methods and equipment for achieving extreme high vacuum (10^{-12} torr) are discussed. Phenomena that occur in simulated interplanetary environs such as solids fusing on contact and dust piles supporting weight are briefly described. (C.E.S.)

41631 ION PUMPING. Vance E. Hoffmann (Varian Associates, Palo Alto, Calif.). Ind. Res., 46-58(Sept. 1964).

The design, performance, operation mechanisms, and problems associated with ion pumps for high vacuum systems are discussed. (C.E.S.)

41632 MEASUREMENTS WITH A MODULATED BAYARD-ALPERT GAUGE IN ALUMINOSILICATE GLASS AT PRESSURES BELOW 10^{-12} TORR. J. P. Hobson (National Research Council, Ottawa). J. Vacuum Sci. Technol., 1: No. 1, 1-6(Sept.-Oct. 1964).

The background conditions achieved in a simple ultrahigh-vacuum system with an envelope of aluminosilicate glass (Corning 1720) have been studied. Pressures were measured by a dynamic method and also with a modulated Bayard–Alpert gage. Good agreement between the two methods was obtained using a modified analysis for the modulated gage. A total pressure of 8×10^{-13} torr (equivalent nitrogen) was measured with the whole system at room temperature, and one of 7×10^{-15} torr (equivalent nitrogen) was measured with a portion of the system immersed in liquid helium. A discussion is given of variations in the residual modulation factor of the gage in the presence of extremely low gas pressures. (auth)

41633 ION GAUGE CALIBRATION AT LOW PRESSURES USING A LEAK DETECTOR. B. Bergsnov-Hansen, N. Endow, and R. A. Pasternak (Stanford Research Inst., Menlo Park, Calif.). J. Vacuum Sci. Technol., 1: No. 1, 7-9(Sept.-Oct. 1964). (TID-20838)

A simple method for ion gage calibration is presented. The flow rate of a pure gas through the calibration cell and a known conductance is measured with a leak detector (or a residual gas analyzer) on the high pressure side of the diffusion pump. From the known conductance and the measured flow rate the calibration pressure is calculated. Pumping by walls and gage does not interfere with calibration, since it is based on the flow rate out of the calibration cell. This method is illustrated by calibrating an ion gage for helium and deuterium using a standard helium leak detector as the flowmeter. (auth)

41634 RESIDUAL ARGON PARTIAL PRESSURE CHANGES DUE TO AN INTERMITTENTLY OPERATED BAYARD-ALPERT IONIZATION GAUGE IN ULTRAHIGH VACUUM. M. Friedman Axler (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). J. Vacuum Sci. Technol., 1: No. 1, 17-18(Sept.-Oct. 1964).

In a sealed ultrahigh-vacuum glass system incorporating a Bayard–Alpert ionization gage at a total pressure of $\sim 10^{-10}$ torr (obtained with an oil diffusion pump, mechanical fore-pump, and nonrefrigerated trap), it is demonstrated that by turning off the electron accelerating potential (or all gage potentials) of the ionization gage, the ambient gas of the system is perturbed by the desorption of Ar from the gage surfaces. Partial-pressure gas measurements are made with an omegatron mass spectrometer. The quantity and rate of Ar desorption are related in a complex way to the previous history of the system. Experimental data for some representative systems are presented. (auth)

41635 HYDROCARBON FORMATION IN ION PUMPS. David Lichtman (Honeywell Research Center, Hopkins, Minn.). J. Vacuum Sci. Technol., 1: No. 1, 23-4(Sept.-Oct. 1964).

After pumping D_2O to a pressure of 10^{-9} torr with an ion pump, the pump is turned off, and the spectrum of the evolving gases is studied. Hydrocarbons are evolved, in both the normal and deuterated forms. It is concluded that the results verify the hypothesis that some, if not all, of the hydrocarbons observed emanating from an ion pump are synthesized from the hydrogen- and carbon-containing molecules being pumped. (T.F.H.)

41636 ULTRA-HIGH VACUUM IN APPARATUS WITHOUT PRE-CONDITIONING. L. L. Gerasimov, N. P. Danilova, and A. I. Shal'nikov (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 4, 155-6(July-Aug. 1964). (In Russian)

A vacuum less than 10^{-2} torr was obtained in a nonpreconditioned apparatus using a liquid-helium trap and was measured by a cold magnetic-ionization manometer. (tr-auth)

41637 REACHING 1×10^{-10} TORR WITH MECHANICAL PUMPING. Gordon F. Osterstrom. Res. Develop., 15: No. 9, 62-5(Sept. 1964).

The development and characteristics of the turbomolecular pump are outlined. A pump of this type has been built with a 50 k liter/sec capacity. Pressures on the order of 10^{-10} torr are attainable with these pumps. (T.F.H.)

GEOLOGY AND MINERALOGY

General

41638 (ORNL-P-302) CORRELATION OF CONVERGENCE MEASUREMENTS IN SALT MINES WITH LABORATORY CREEP-TEST DATA. R. L. Bradshaw, W. J. Boegly, and F. M. Empson (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 18p. (CONF-702-1)

From 6th Symposium on Rock Mechanics, Rolla, Mo., Oct. 1964.

Laboratory pillar model tests, of 1000 hr or less duration, run at several different values of average pillar stress, appear to be sufficient to allow the development of an empirical equation which can be used to predict vertical closure rates in salt mine openings up to 70 years old. Vertical convergence rates have been shown to continue to decrease with time in openings up to 12 years old where the pillar stress is well below the ultimate strength. Accumulation of data at individual stations in older openings is not yet sufficient to determine with certainty if the closure rates are still decreasing after several decades, but the data from the collective stations seem to indicate that rates are still decreasing after 70 years. Horizontal closure rates (and thus transverse pillar expansion rates) appear to be considerably lower than the vertical closure rates for the first few years after an opening is created. It is thus possible that transverse pillar expansion tends to approach a nearly constant rate after a short period of time, although the data also indicate that, after about 10 years, the transverse expansion rate in in./yr tends to approach the vertical convergence rate. (auth)

41639 (TEI-850) GEOLOGIC MAP OF THE SILENT BUTTE QUADRANGLE, NYE COUNTY, NEVADA. E. B. Ekren, R. E. Anderson, Paul P. Orkild, and E. N. Hinrichs (Geological Survey, Washington, D. C.). Sept. 1964. 16p.

41640 THE MARINE GEOCHEMISTRY OF STRONTIUM. Karl K. Turekian (Yale Univ., New Haven). Geochim. Cosmochim. Acta, 28: 1479-96(Sept. 1964).

A study of the path of strontium to and through the sea was made with the aid of 150 new analyses of deep-sea cores for strontium and available data on the parts of the surficial Earth involved in the cycle. Most of the strontium supplied to the sea is from limestones through weathering and loss during diagenesis. The major part of the strontium and calcium reaching the sea is taken out in the deep sea at present. If the deep-sea calcium carbonate, with its associated strontium, is not effectively recycled, the strontium-calcium ratio of streams and the ocean would be expected to decrease with time. The apparently long time constant for change in the strontium-calcium ratios of streams coupled with the diagenetic alteration of possible records of ancient oceanic compositions in fossil shells prohibits a quantitative evaluation of the possibly small change in the strontium-calcium ratio in the oceans during the Phanerozoic. (auth)

41641 OXYGEN ISOTOPE FRACTIONATION BETWEEN COEXISTING CALCITE AND DOLOMITE. Jon N. Weber (Pennsylvania State Univ., University Park). Science, 145: 1303-5(Sept. 18, 1964).

The oxygen isotopic composition of calcite from carbonate rocks of the lower unit of the Flagstaff formation (Paleocene) exposed along the western margin of the Wasatch Plateau, Utah, was determined to be about 7 per mil lower than that of coexisting dolomite, suggesting that isotopic equilibration of these two minerals can occur at relatively low temperatures. The data do not preclude a primary chemical origin for the dolomite. (auth)

Natural Radioactivity and Fallout

41642 (DASA-1308) PROJECT STAR DUST. Eighth Quarterly Report. James P. Friend, Herbert W. Feely, and Micah W. M. Leo (Isotopes, Inc., Westwood, N. J.). May 1, 1963. Contract DA-49-146-XZ-079. 44p. (AD-600602)

High concentrations of total beta activity and of short-lived fission products, such as ^{140}Ba, were found in the stratosphere of the Northern Hemisphere during late 1962 and early 1963, mainly as a result of the late 1962 Soviet series of nuclear weapons tests. The apparent stratospheric burden of ^{90}Sr, as calculated from the distribution of that nuclide in the Star Dust sampling corridor, increased to approximately 7.8 MC by Jan. and Feb. 1963. The apparent burden of ^{54}Mn in the stratosphere of the Northern Hemisphere, corrected for decay to October 15, 1961, reached 45 MC by late 1962 and 75 MC by Jan. and Feb. 19, 1963. This was concluded to indicate that large amounts of ^{54}Mn were produced during the 1962 Soviet test series as well as during the 1961 test series. Large quantities of ^{124}Sb were produced during the 1962 Soviet test series, apparently by the late Dec. 1962 tests. The stratospheric distribution of the cosmic-ray product, ^{7}Be, approximated theoretical distribution during early 1960 and mid 1961, but artificial ^{7}Be produced during the 1961 Soviet and 1962 U. S. test series distorted the distribution of this nuclide during 1962. (auth)

41643 (DPSPU-64-30-2) EFFECT OF THE SAVANNAH RIVER PLANT ON ENVIRONMENTAL RADIOACTIVITY. Semiannual Report, January–June 1964. C. Ashley (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). Contract [AT(07-2)-1]. 15p.

Results of the environmental monitoring program for the atmosphere, for vegetation and food, and for water are presented for the period January 1 through June 30, 1964. The quantity of radioactive waste released by the Savannah River Plant to its environs was, for the most part, too small to be distinguished from natural background radiation, or was obscured by world-wide fallout from nuclear weapons testing during past years. Beta activity in air, which shows no relationship with Plant operations, was about one-eighth of that for the same period of 1963. Radionuclides in milk were at the same levels as those reported for most sections of the United States by the U. S. Public Health Service. The concentration of radioactive materials in river algae indicated some slight contribution from the Plant. Radioactive materials in fish flesh continued to be far below levels considered significant from a health standpoint. In no instance was the concentration of radionuclides in river water in excess of 3.3% of the Maximum Permissible Concentration. (auth)

41644 (HASL-149) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, JUNE 1, 1964–SEPTEMBER 1, 1964. Edward P. Hardy, Jr., and Joseph Rivera

(New York Operations Office. Health and Safety Lab., AEC). Oct. 1, 1964. 171p.

Data are presented on radionuclide levels in fallout, world-wide soils collected in 1963–64, milk, tap water, and upper air samples. Also included are interpretive reports and notes dealing with strontium-90 levels in the diets and bones of Argentine children and San Juan, Puerto Rico residents, cesium-137, stable strontium, and radium-226 in two human skeletons, latitudinal deposition of strontium-90 in the United States, a statistical analyses of the 1963–64 soils analytical data, and expected and measured plutonium-238 concentrations in air from a satellite failure. A bibliography of recent literature pertinent to fallout studies is included. (C.H.)

41645 (HW-80500(p.177-80)) DEPOSITION OF I^{131} ON VEGETATION. J. F. Cline, D. O. Wilson, and F. P. Hungate (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The effective half life of gaseous deposited ^{131}I on leaf tissue was four to five days in a field experiment. About half of the deposited iodine was shown to re-enter the atmosphere from the vegetation apparently by sublimation. Water, a detergent, collodion, and silicon rubber removed 30, 40, 82, and 60%, respectively, of deposited ^{131}I from leaf surfaces. (auth)

41646 (HW-80500(p.191-4)) SECOND SURVEY OF RADIOACTIVITY IN NORTHERN ALASKAN NATIVES AND THEIR FOODS, SUMMER 1963. W. C. Hanson, H. E. Palmer, B. I. Griffin, and D. M. Fleming (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A second survey of radionuclides in northern Alaskan Eskimos and their foods was conducted during the summer of 1963. Methods and procedures were similar to those employed in 1962. The same counting locations as utilized during 1962 (Anaktuvuk Pass, Barrow, Kotzebue, and Point Hope) were revisited and 498 native residents were scanned; as many persons as possible were reexamined. In addition, 90 native residents of the Athapascan Indian village of Fort Yukon were scanned to provide comparison between natives who utilized moose as a major food source during fall and winter months with those who relied upon caribou and reindeer during those seasons. Cesium-137 was again the most important fallout radionuclide detected in whole-body gamma spectra. Estimated ^{137}Cs body burdens in various age and ethnic groups maintained the same general ranking as in 1962. Average ^{137}Cs body burdens were greatest in natives between 21 and 50 years of age; children (ages 5 through 20 years at Anaktuvuk Pass, 12 through 20 at other villages) contained appreciably less ^{137}Cs than adults. Maximum ^{137}Cs values were found among Anaktuvuk Pass residents, where the average adult contained about four times as much ^{137}Cs as the next highest ethnic group compared to a threefold disparity noted in 1962. Lowest average adult ^{137}Cs body burdens occurred among Fort Yukon residents. These people do not practice the storage of meat in frozen caches common among Eskimos and thus utilized caribou and moose sparingly during spring and summer months, thereby reducing their ^{137}Cs intake. A few samples of moose flesh obtained from native sources contained ^{137}Cs concentrations one-third to one-thirtieth those in caribou flesh collected at the same time and place. A maximum body burden of 1,200 nc ^{137}Cs was detected in an Anaktuvuk Pass adult male, compared to a maximum of 790 nc observed last year. Except among Kotzebue and river village residents, average ^{137}Cs body burdens were greater during 1963 than during 1962, presumably because ^{137}Cs concentrations in caribou flesh obtained from native sources were greater than those observed in 1962. A modified interview form for determining seasonal food consumption rates of subjects indicated caribou and/or reindeer consumption by the Eskimos was generally less during 1963 than during 1962 except at Anaktuvuk Pass. Some changes in food utilization patterns reported in 1962 were noted, probably due to the different type of interview and normal variation in availability of native foods. (auth)

41647 (HW-80991) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD FOR 1963. R. H. Wilson, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 24, 1964. Contract AT(45-1)-1350. 199p.

An evaluation of results obtained from the Hanford environmental surveillance program for 1963 indicates that most of the environmental radiation exposure for the majority of persons in the neighborhood of the Hanford project was due to natural sources and world-wide fallout rather than to Hanford operations. Of the low-level wastes released to the environment from the Hanford plants, neutron-induced radionuclides present in reactor cooling water discharged to the Columbia River continued to be the source of greatest potential exposure to the people in the environs. The primary mechanisms of exposure from this source are drinking water derived from the river and consumption of fish and waterfowl which inhabit the river. The amount of ^{131}I in the Hanford environs was substantially less than in the previous 2 years when extensive testing of weapons was in progress. Nevertheless, world-wide fallout continued to be the dominant source of the ^{131}I found locally, except for the month of September when abnormally large amounts were released from one of the chemical separations plants. For the calendar year 1963, the ^{131}I in milk from local farms could have resulted in radiation exposures to the thyroids of infants of approximately 10% of the Federal Radiation Council Radiation Protection Guide. (auth)

41648 (NP-14254) RADIOACTIVE POLLUTANTS IN THE ENVIRONMENT. (Public Health Service, Washington, D. C. and Robert A. Taft Sanitary Engineering Center, Cincinnati). Feb. 1964. 325p.

This manual was compiled for use in a course designed to provide trainees with the minimum basic technical knowledge necessary for environmental radiation surveillance work. Fundamentals of radiation, sources of radioactivity in the environment, and the biological effects of radiation are reviewed. Analytical procedures and radiation detection instruments are described for the determination of radioactivity in air, water, and food. Emphasis is placed on fallout monitoring. 105 references. (C.H.)

41649 (TID-20955) A STUDY OF ARTIFICIAL AND NATURAL RADIOACTIVE CONTAMINATION IN BRAZIL. F. X. Roser, G. H. Kegel, L. Hainberger, T. L. Cullen, and R. T. Drew (Pontifícia Universidade Católica, Rio De Janeiro. Instituto de Física). Aug. 1, 1964. Contract AT(30-1)-2577. 84p.

Preliminary results are reported from studies of two regions of high natural radioactivity in Brazil. About 20,000 people are exposed to abnormally high concentrations of U or Th in monazite sand along the Atlantic coast. The towns of Guaraparí and Meaipe, where some 5000 people are exposed to radiation levels ranging from 0.03 to 1.0 mR/hr, were chosen for study. The towns of Morro de Ferro and Araxá were studied in the State of Minos Gerais, where radioactive volcanic extrusions are found. Radiochemical analyses were made of drinking water, and measurements were made of the radioactivity of soil, selected biological samples, and a sample of the human population. Data are included on radioactivity due to fallout in samples of air and rain water collected at 10 sampling stations in Brazil. (C.H.)

41650 (UCRL-7945-T) INFORMATION INTEGRATION SYSTEM FOR LRL-L PROGRAM ON MAN-MADE RADIATION IN THE BIOSPHERE. Arthur R. Tamplin and Jason L. Minkler (California. Univ., Livermore. Lawrence Radiation Lab.). July 15, 1964. Contract W-7405-eng-48. 60p.

An information integration project is described that was developed for use as a research tool to facilitate the solution of problems in the shortest period of time with optimum utilization of personnel. A thorough search, abstraction, and analysis of the existing world-wide literature and, on a continuing basis, of the current literature, provides data that are coded on IBM cards using a system that designates general categories of information and specific kinds of information within the particular category. Four separate coding formats were adopted for transcribing information onto the cards that constitute the input into the electronic computers for subsequent information retrieval. The system will allow the retrieval of specific pieces of information and additional collateral information related to the problem of interest. An application of the program in studies on man-made radiation in the biosphere is described in detail. The overall mission problem is divided into 3 major categories: sources of the radionuclides, transport of the radionuclides from the source, and interaction of the radionuclides with the biosphere. The information integration system will be used to reveal areas in which experimental studies are needed. (C.H.)

41651 THE ANOMALOUS NATURE OF IVIGTUT LEAD. T. J. Ulrych (Univ. of Western Ontario, London, Can.). Geochim. Cosmochim. Acta, 28: 1389-96(Sept. 1964).

Five analyses were made on the lead of Ivigtut, Greenland and are considered to establish definitely the anomalous nature of the lead. The samples, which consist of pyrite and galena, were compared with a standard in a gas-source mass spectrometer using a free radical technique for the preparation of lead tetramethyl. The lead isotope ratios from Ivigtut are linearly related on a plot of ^{207}Pb/^{204}Pb vs ^{206}Pb/^{204}Pb with a slope of 0.113 ± 0.004. The deviation of points from their best straight line is 0.03% of the average ^{207}Pb/^{204}Pb ratio. The isotopic analyses were interpreted to indicate that the Ivigtut leads were deposited at a time not earlier than 1100 ± 40 m.y. ago and that the source material for the anomalous lead component came into existence between 1880 ± 60 and 1100 ± 40 m.y. ago. Ordinary lead mineralization occurred at least 2980 ± 10 m.y. ago. A possible application of lead isotope studies to problems of continental drift is discussed. (P.C.H.)

41652 AN ISOTOPIC STUDY OF LEAD IN SEDIMENTARY PYRITE. J. M. Wampler and J. L. Kulp (Columbia Univ., Palisades, N. Y.). Geochim. Cosmochim. Acta, 28: 1419-58(Sept. 1964).

The lead content of thirty samples of pyrite from sedimentary and metasedimentary rocks was determined by x-ray fluorescence spectrometry. Lead content ranges from a few ppm to several hundred ppm in both the sedimentary and metasedimentary samples. The uranium content of most of the samples was determined by isotope dilution; much of the uranium, and in some cases much of the lead, associated with the samples could be removed by leaching for several days in hot HCl. The U/Pb ratio of most of the leached samples is sufficiently low that the contribution of radiogenic lead by decay of the uranium is negligible. The isotopic abundances of lead, in the samples for which the sedimentary age is known, are related to a two-stage model for the isotopic development of oceanic lead based on the isotopic composition of lead in the modern North Pacific. This model provides reliable minimum ages for the time of deposition of the samples and in many cases this minimum age is within a few hundred million years of the known age. A few samples that show larger deviations apparently originated in restricted basins of deposition. Samples from black schists in Finland contain excess ^{206}Pb that probably originated in black shale environments prior to metamorphism. Other samples from Finland, and a sample from the Canadian shield, give model ages considerably greater than the latest metamorphism, suggesting intervals of at least several hundred million years between sedimentation and metamorphism. (P.C.H.)

41653 GAMMA RADIATION FIELD OF RADIOACTIVE CONTAMINATION OF GROUND ATMOSPHERE. Yu. A. Izrael. Izv. Akad. Nauk SSSR, Ser. Geofiz., No. 7, 1103-13 (July 1964). (In Russian)

The γ dose and intensity in ground-level atmosphere over a contaminated area were calculated considering only surface contamination. It is shown that at 200 m elevation the relation between dose and surface contamination does not depend on the initial γ energy. The effects of conditions (air distribution over the surface, ground unevenness, vegetation layer, and meteorological conditions) were estimated on the basis of calculations and model experiments. (tr-auth)

41654 STUDY OF THE RADIOACTIVITY OF HOKUTOLITE. Hiroshi Hamaguchi, Yuan-tseh Lee, and Hwasheng Cheng (Tsing Hua Univ., Hsinchu, China). J. Chinese Chem. Soc. (Taiwan), 9: 1-13(Mar. 31, 1962).

Radioactive equilibria in the hot springs sediment, Hokutolite, were studied. The activity ratio of U series to Th series was calculated and the contents of the U series and Th series were determined by absolute counting of β particles using a constant geometry method. The following nuclides were detected: ^{210}Pb and ^{212}Pb in the lead portion, ^{210}Bi and ^{212}Bi in the bismuth portion, and ^{228}Ac in the hydroxide portion. It was shown that the radioactive series in Hokutolite starts from Ra and the activity ratio of U series to Th series is close to 4. The Ra content of the Hokutolite was estimated as 1.5×10^{-11} g/g. (auth)

41655 ON THE FILTER SATURATION METHOD FOR RECORDING DAILY ATMOSPHERIC RADIOACTIVITY. V. P. Matulyavichyus (Inst. of Geology and Geography, Academy of Sciences, Lithuanian SSR). Lietuvos TSR Mokslu Akad. Darbai, Ser. B., No. 1, 29-33(1964). (In Russian)

Radioactivity near Vilnius in 1961 was monitored using a device equipped with an aspiration recorder with a moving filter (ribbon rates of 20, 40, and 60 min/hr) and having a capacity of 1 to 20 m^3/hr. The saturated filter method exhibited considerable inertia due to filter surface contamination. The inertia was estimated. Sharp variations in the natural radioactivity of the lower atmosphere were also considered. The method, with automatic background compensation, proved efficient for monitoring atmospheric fallout contamination. (R.V.J.)

41656 ON THE SELECTIVITY OF CERTAIN METHODS FOR TRAPPING RADIOACTIVE SPECIMENS IN AIR.

B. I. Styro and V. P. Matulyavichyus (Inst. of Geology and Geography, Academy of Sciences. Lithuanian SSR). Lietuvos TSR Mokslu Akad. Darbai, Ser. B, No. 1, 35-44 (1964). (In Russian)

Comparisons of four methods indicated that a fiber filter is the most efficient for trapping radioactive aerosol particles. The suspended Geiger-Mueller counter was not efficient and could be used for only general dosimetry. Dynamic cyclones were capable of trapping only coarse particles (5 to 7 μ), which contained only 1% of the radioactivity recorded using filters. Charged wires trapped about 10 to 15% of the total aerosol activity with a tendency toward selectivity for fine particles carrying radon products. Its efficiency for fallout radioactivity was only about 2 to 5% that of the filter. (R.V.J.)

41657 INVESTIGATION OF NUCLEAR WEAPON DEBRIS WITH X-RAY MICROANALYSER. J. Sisefsky (Research Inst. of National Defence, Stockholm). Nature, 203: 708-10(Aug. 15, 1964).

An autoradiographic technique is described for the identification and microscopic examination of fallout particles among air-borne dust particles. High-altitude and ground-air samples were continuously collected and autographed on x-ray films. Large spots on the autoradiograms were used to locate radioactive particles on the filter papers. The filter areas were punched out and the pieces stirred with a viscous gelatin solution to make a homogenous solution that was plated on glass. The position of the particles was indicated by a second autoradiogram and the corresponding gelatin-layer pieces punched out. In this were active particles that were freed from most of the accompanying dust. The pieces of gelatin were dissolved in water, mixed with nuclear emulsion and plated on glass, processed, and examined with an x-ray microanalyzer. The content of Fe, Al, Si, Pb, and U was determined by this method. The particles were individually measured in a low-background β counter and, if strong enough, in a γ counter for identification of fission products. Results are reported from the examination of 700 samples from a total of 1.2 kt of air in which about 20 large particles were found. (C.H.)

41658 THE CONCENTRATION OF NATURAL RADIOISOTOPE FRAGMENTS IN THE BIOSPHERE. L. A. Pertsov. Radiobiologiya, 4: 619-23(1964). (In Russian)

In addition to the artificial fission fragments, the biosphere contains also the fragments resulting from the spontaneous fission of heavy nuclei. The probability of the spontaneous binary fission of a nucleus in two highly asymmetric fragments is very low. It has been established that ^{238}U is undergoing spontaneous fission at a somewhat faster rate than ^{235}U. Calculations yielded the following spontaneous fission half life values: $^{238}\mathrm{U} = 8.04 \times 10^{15}$ years; $^{235}\mathrm{U} = 1.87 \times 10^{17}$ years; $^{232}\mathrm{Th} = 1.35 \times 10^{18}$ years. These figures indicate that the contribution of the thus formed radioisotopes to the total activity of the biosphere must be extremely small. However, these isotopes may reach an equilibrium and could participate in the various material cycles in nature. Obviously, they are expected to be present in substrata containing large concentrations of U or Th and in materials possessing a marked selective adsorptivity toward these elements. A review of these processes allowed the conclusion that there is a whole series of naturally formed radioisotopic fragments which have not been taken into consideration before. They include ^{90}Sr, ^{137}Cs, and probably also ^{106}Ru, ^{144}Ce, ^{147}Pm and possibly also other isotopes with a relatively long half-life. (TTT)

41659 STOCKHOLM NATURAL TRITIUM MEASUREMENTS. [PART] I. Goete Oestlund and Lars B. Lundgren (Radioactive Dating Lab., Stockholm). Tellus, 16: 118-30 (Feb. 1964).

The methods and standards used at the laboratory to determine tritium in natural waters are briefly described, and results are reported on the controversial rain water samples from Valentia, Ireland. The results of deuterium and tritium determinations in rain and other waters are tabulated, including data on precipitation from global and Scandinavian networks and rivers feeding into the Baltic Sea. (D.C.W.)

41660 STANDARDIZATION OF NATURAL TRITIUM MEASUREMENTS. H. Goete Oestlund (Radioactive Dating Lab., Stockholm), Robert M. Brown, and Arnold E. Bainbridge. Tellus, 16: 131-4(Feb. 1964).

A series of water samples prepared in Stockholm from tritium-free water and NBS-standard tritiated water were used to check the accuracy of natural tritium measurements in three laboratories. There is evidence of pick-up during analysis to the extent of 1-2 TU in one of the laboratories, but otherwise all results from the three laboratories agreed well with the values calculated from preparation of the samples. Agreement was also obtained on a second series of reference samples prepared and distributed by the International Atomic Energy Agency, Vienna. (auth)

41661 STRONTIUM 90 IN RAIN DUE TO NUCLEAR TESTS AT HIGHER LATITUDES. J. F. Bleichrodt and J. Blok (National Defence Research Organization, TNO, Rijswijk, Z.H., Netherlands). Tellus, 16: 135-8(Feb. 1964).

In The Netherlands, concentrations of ^{90}Sr in rain during 1959, 1962, and 1963 originating from Soviet nuclear tests in the fall of 1958, 1961, and 1962, respectively, were approximately proportional to that part of the fission yield which corresponds to debris introduced into the lower stratosphere. (auth)

41662 OBSERVATIONS ON RADIOACTIVE PARTICLES OF THE FALLOUT OF 1961 AND 1962 BY MEANS OF AN ELECTRON MICROSCOPE AND A METHOD OF MICROANALYSIS WITH X RAYS. Manfred F. Rajewsky (Max-Planck-Institut für Biophysik, Frankfurt am Main). 12p. (CONF-337-17). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The results of studies made on the particle size, chemical composition and distribution of radioisotopes in the particles, and solubility of the radioactive particles in biological milieu are reported. The investigation was carried out on fallout collected in 1961 and 1962 at the Max Planck Institute. The particles were found to have a crystalline structure and a high percentage of non-radioactive material. Fe was found to be a constituent of all the particles analyzed, and only one particle appeared to contain no Al. The characteristics of the particles analyzed are tabulated. (J.S.R.)

41663 ON THE MEASUREMENT OF IODINE-131 IN THE PRECIPITATIONS AND IN THE LOWER ATMOSPHERE NEAR THE EARTH BY MEANS OF A NETWORK OF OBSERVATIONS. Max F. E. Hinzpeter. 14p. (CONF-337-26). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The relation of the ^{131}I content in precipitations and in the atmosphere near the ground was investigated on the basis of measurements made in West Germany from Aug. 16, 1962, to Feb. 20, 1963. Expressions were derived for calculating the ^{131}I in rain and snow. The distribution curve of differences between measured and calculated values indicate in good approximation a normal distribution. (J.S.R.)

41664 NATURAL ATMOSPHERIC β ACTIVITY AND METEOROLOGICAL FACTORS. J. J. Martin and B. Gachot. 19p. (CONF-337-13). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The causes of the variation of the atmospheric β activity at ground level were investigated. The existence of relations between the activity and various meteorological factors (relative humidity, temperature, vertical temperature gradient, wind velocity at ground level, and amount of precipitation) was determined, and the nature and intensity of these relations were determined by statistical methods. There was a clear correlation between the atmospheric activity and all these factors except amount of precipitation. (J.S.R.)

Site Survey and Selection

41665 THE INFLUENCE OF THE UNEVEN TERRAIN ON THE γ FIELD OVER THE AREA CONTAMINATED BY A FALL OUT. Yu. A. Izrael. At. Energ. (USSR), 17: 137-40(Aug. 1964). (In Russian)

Results are described from model experiments on the determination of the effect of unevenness of terrain on the γ field over an area contaminated by radioactive fallout. On the basis of experiments and calculations, values are obtained for coefficients accounting for the effect of microrelief on an area with varying surfaces (virgin grassy parts, dry steppe, field). (tr-auth)

41666 A PRELIMINARY HYDROGEOLOGICAL AND HYDROGEOCHEMICAL SURVEY OF THE ARRONE RIVER BASIN IN VIEW OF A POSSIBLE IMMISSION OF RADIOACTIVE EFFLUENTS. Mario Dall'Aglio and Giovanni P. Giannotti. Comit. Nazl. Energia Nucl., Notiziario, 10: No. 6, 31-45(June 1964). (In Italian)

The results of a hydrogeological and hydrogeochemical study of the Arrone River basin are reported with consideration of the possibility of the immission of radioactive effluents from the Casaccia Nuclear Center. Preliminary and detailed geological maps were made. Discharge measurements and chemical analysis of 38 samples of Arrone River water, springs, and wells were also performed. (tr-auth)

Techniques and Equipment

41667 A SEISMOMETRIC STUDY OF THE RUSSIAN NUCLEAR EXPLOSION ON 30 OCTOBER 1961. B. P. Saha (Central Seismological Observatory, Shillong, Japan). Indian J. Meteorol. Geophys., 13: 232-6(Apr. 1962).

The characteristics of the seismic waves generated by the Russian high-altitude explosion are discussed. (C.E.S.)

Thorium and Uranium Minerals

41668 (CEA-R-2437) LES EQUILIBRES RADIOACTIFS DES MINERAIS URANIFERES DANS QUELQUES PROBLEMES DE GEOLOGIE APPLIQUEE. (Radioactive Equilibrium of Uranium-Bearing Ores in Some Problems of Applied Geology). Rene Coulomb, Philippe Girard, and Marcel Goldsztein (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). July 1964. 41p.

The state of equilibrium between several nuclides in radioactive relationship is determined with accuracy by the fundamental equations of radioactivity. It can be measured physically and expressed in suitable and internationally adopted units. Equilibrium-disequilibrium of uranium-bearing ores is a fairly complex phenomenon but the problems can be much simplified by well-chosen approximations in various practical field cases. The results of radiometric and radiochemical measurements lead to the interpretation of geochemical anomalies and may be used in the qualitative and quantitative estimation of uranium bearing depositis. (auth)

41669 GEOCHEMICAL BEHAVIOR OF Ta, Th, Co, Sc, AND U IN THE LAVAS OF CHAINE DES PUYS. R. Coulomb and M. Goldsztejn (CEA, Fontenay-aux-Roses, France). Bull. Soc. Franc. Mineral. Crist., 87: 163-5(Apr.-June 1964). (In French)

Thirty-five lavas of the Chaine des Puys extending from basalts to domites and including trachyandesites were studied. The behavior of some oligoelements during magmatic differentiation was determined. Some of them having a marked affinity for a major element enter in the composition of minerals formed during differentiation. There is then enrichment toward one pole. In other cases, the trace element does not enter any crystalline structure and is found dispersed in the clay. (tr-auth)

41670 GEOPHYSICAL PROSPECTING FOR URANIUM BY THE NUCLEAR ENERGY COMMISSION. F. Zuriaga Coll (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 7: 10-20(Apr.-June 1964). (In Spanish)

The principles of the methods used in geophysical prospecting for uranium, particularly resistivity charts, are briefly summarized. The interpretation of resistivity charts and the equipments used in making such charts are described. Data on the prospecting studies carried out in Andujar, Caceres-Badajoz, and Salamanca sectors are tabulated. (J.S.R.)

41671 APPLIED GEOLOGY IN THE SHIRLEY BASIN URANIUM DISTRICT, WYOMING. Robert V. Bailey (Utah Construction and Mining Co., Salt Lake City). 10p. (CONF-656-2)

From 9th Annual Minerals Symposium, Moab, Utah, May 1964.

At Utah Construction & Mining Co.'s Shirley Basin underground mine in the central part of southeast Wyoming, uranium ore has been mined from poorly consolidated sand units in the Eocene Wind River formation. Loose ground and abundant water created difficult mining conditions. A geologic mapping program of the mine, accompanied by detailed drill hole logging and geologic cross section construction, has revealed habits and relationships of the mineralization and associated alteration. Mineralization and ore were found to lie along the periphery of tongues of altered ground. The greenish to rusty altered ground was usually recognizable in hand specimen and represented "leached" ground through which mineralizing solutions had passed. The major tongue of alteration was found to be as much as 70 feet thick, hundreds of feet across, and several miles long. The best ore occurs on rolls, or geochemical fronts, at the terminal edges of altered ground, and additional ore was found to occur in subsidiary rolls on the upper and lower surfaces of the altered ground. This concept of ore occurrence has been successfully applied to exploration and development drilling, to ore projections ahead of mine workings, and to reserve estimates. (auth)

HEALTH AND SAFETY

Refer also to abstracts 41360, 41598, 41950, 42150, 43045, and 43081.

41672 (ANL-6884) A COMPENDIUM OF RADIATION SAFETY INFORMATION ABOUT PLUTONIUM. Frank P. Marchetti (Argonne National Lab., Ill.). Apr. 1964. Contract W-31-109-eng-38. 20p.

Radiation safety information pertaining to Pu is summarized and presented in a convenient reference form for personnel working with the element. Emphasis is placed on control measures for work involving ^{239}Pu. The physical and biological properties and hazards involved when Pu enters the body are discussed. 20 references. (C.H.)

41673 (EUR-1850.e(p.117-26)) EURATOM'S SCIENTIFIC AND TECHNICAL ACTIVITIES IN THE FIELD OF HEALTH AND SAFETY. P. Recht (European Atomic Energy Community).

A review is presented of Euratom activities in the areas of environmental and food contamination by radioactivity, radioactivity in the Rhine river, atmospheric radioactivity, dosimetry, and personal attitudes toward radiological hazards. (J.R.D.)

41674 (EUR-1850.e(p.127-34)) POWERS AND ACTIVITIES OF EURATOM IN THE FIELD OF RADIATION PROTECTION. E. Jacchia (European Atomic Energy Community).

The power exercised by EURATOM in establishment of radiation protection standards is reviewed. Discussions are included concerning the processes by which compliance with these standards is obtained. (J.R.D.)

41675 (EUR-1850.e(p.195-200)) PROBLEMS RELATING TO THE TRANSPORTATION OF MTR-TYPE IRRADIATED FUELS. R. Scalliet (European Atomic Energy Community).

An account is given of actions taken by the Commission to ensure proper conditions for transportation of irradiated fuels from the HFR, BR-2, and ISPRA 1 reactors to processing plants. The aspects considered include destination of the fuel, provision of transportation containers, and costs related to transportation and third-party nuclear liability insurance coverage. (J.R.D.)

41676 (HW-82254(Rev.)) NUCLEAR SAFETY GUIDANCE IN THE USE OF WATER TO FIGHT FIRES IN CPD FACILITIES. R. E. Tomlinson, comp. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 28, 1964. Contract AT(45-1)-1350. 7p.

The risk of criticality in the use of water to fight a fire in a radiochemical processing facility where Pu is involved is assessed. Ways are described in which water, preferably as high expansion foam or as fog, can be used with minimum risk of causing criticality. Pertinent parameters are outlined for fire fighting at Hanford facilities. (C.H.)

41677 (MTP-AERO-64-4) SPACE RADIATIONS: A COMPILATION AND DISCUSSION. W. T. Roberts (National Aeronautics and Space Administration. George C. Marshall Space Flight Center, Huntsville, Ala.). Jan. 21, 1964. 24p. (NASA-TMX-54700; N64-17610)

The natural radiations encountered during a space mission will fall into one of five categories. There will be Van Allen belts, galactic cosmic radiations, solar winds, solar flares, and photon radiations. Each type of radiation is examined from the point of view of the Apollo program and the associated lunar logistics vehicle, but with some comments pointing to extended missions in space, to determine the importance that should be assigned to each class. (auth)

41678 (NOLTR-64-21) DUNC "THRESHER RADIATION SURVEY." Gordon K. Riel, Donald G. Simons, and P. V. Converse (Naval Ordnance Lab., White Oak, Silver Spring, Md.). Feb. 3, 1964. 43p. (AD-601084)

A radiation survey was made in the area of the Thresher sinking using the DUNC underwater gamma spectrometer. Any release of fission products added less than 3% to the normal radioactivity of the water. Other, less sensitive, gamma spectrometers were used to survey larger areas and to test points on the bottom. No fission products were found. (auth)

41679 (NYO-841-1) AIR CLEANING STUDIES PROGRESS REPORT FOR JANUARY 1, 1963–JUNE 30, 1964. Richard Dennis and Leslie Silverman (Harvard Univ., Boston. School of Public Health). July 1964. Contract AT(30-1)-841. 84p.

Absorption coefficients were determined for ^{85}Kr on activated C at −13, 0, and 25°C. Desorption characteristics were found to be approximately the same as those for the absorption process. Preliminary tests of Pd–Ag diffusion cells for separation rare gases from reactor H_2 bleed streams are described. In studies of foam-capture of fission products it was found that 2.5% lauryl sulfate with dodecanal stabilizer in water can reduce confined aerosolized I_2 concentrations about 20 times. Further work is required on foam compatability with required chemical additives. Tests were made to determine the maximum height to which high-expansion foams can be pumped in high bay areas. A foam column 51 ft high was produced. Work was continued to develop diffusion boards to relieve vessel pressures in reactor accidents and remove particulate contaminants. Data were obtained on the filtering performance of activated C and silica gel packed in Al cellular cores. Fired ceramic and cellulose fiberboard were found to be very efficient in the collection of solid particles. Investigations of materials for use in collection of I_2 and Br from process off-gas were continued. Silver nitrate-saturated cellulose performed well in cleaning devices. Other materials investigated include Cu foil, silver-impregnated glass, and Al foil. Data are included on I_2 absorption by droplets of aqueous KI and $Na_2S_2O_3$. Work continued on materials which might be dispersed in gases to provide suitable halogen absorption sites. Materials being investigated include $TiCl_4$, activated Al impregnated with $TiCl_4$, MgO, ZrO_2, dioctyl phthalate, and tributyl phosphate. Open field I_2 release studies were conducted which showed that foam systems at present are not suitable for control of short-period outside halogen releases. (J.R.D.)

41680 (RM-4030-TAB) SYSTEMS ANALYSIS FOR THE POSTATTACK ENVIRONMENT: SOME REFLECTIONS AND SUGGESTIONS. R. D. Specht (RAND Corp., Santa Monica, Calif.). Sept. 1964. Contract AT(04-3)-414. 37p.

Some uses and limitations of mathematics and systems analysis in the study of the biological and environmental consequences of nuclear war are discussed. It is suggested that a program of research on problems of the biosphere in the post-attack environment should include not only detailed technical studies, but also some activities devoted to unifying the research approach—facilitating interdisciplinary communication, structuring the program, and discovering what technical studies are needed, in what order, and to what degree of detail. Some suggestions are made for such unifying aids—a "contextual map," special conference design, and a pilot study. (auth)

41681 (TID-7700(p.47-9)) NUCLEAR SAFETY CONSIDERATIONS IN THE TRANSPORTATION AND STORAGE OF FISSILE MATERIAL. David R. Smith (Los Alamos Scientific Lab., N. Mex.).

Problems of storage and shipping of fissile materials are discussed. The AEC Manual Chapter 0529 defines the safety of packages for transportation of fissile materials and has been found to be satisfactory. A brief account is given of Los Alamos activities and experience in shipping. It is pointed out that procedures should be clearly understood by operating personnel and that they should be aware of the consequences of improper procedures and of the nature of accidents which might occur. (D.L.C.)

41682 (TID-7700(p.54-6)) NUCLEAR SAFETY IN URANIUM MATERIALS HANDLING AT THE ORGDP. Albert J. Mallett (Oak Ridge Gaseous Diffusion Plant, Tenn.).

A brief discussion is given of the storage, handling, and shipping problems with uranium materials at the Oak Ridge Gaseous Diffusion Plant. The calculation of spacing between uranium containers is discussed. Both in-plant and out-of-plant shipments are considered. A complete report, including slides, will be available as K-D-1834. (D.L.C.)

41683 (ORNL-tr-270) SOME PROBLEMS OF LIABILITY FOR ATOMIC INJURIES. N. Pelzer. Translated for Oak Ridge National Lab., Tenn., from Atomwirtschaft, [9]: 203-7(May 1964). 26p.

With the signing of the amendment of Jan. 28, 1964 to the Paris Atomic Liability Convention and the Brussels Convention Amendment, another step was taken towards a large-scale overall regulation of atomic liability law. As welcome as this development is, it should not mislead us to the belief that the valid liability law as well as the liability law in the process of being drafted at the present offer complete financial protection against the dangers of atomic energy. In particular, the problems of liability for delayed injuries, proof of cause, personal coverage provision and the liability of the state in the public domain are still extensively unsolved problems. A number of urgent questions concerning liability for atomic injuries are discussed. (auth)

41684 TISSUE ABSORPTION CORRECTIONS FOR LINEAR RADIUM SOURCES. H. F. Batho and M. E. J. Young (British Columbia Cancer Inst., Vancouver, Can.). Brit. J. Radiol., 37: 689-92(Sept. 1964).

A method of correcting γ doses from linear radium sources for apparent absorption in tissue is described. The tissue correction factors which were calculated are based on experimental measurements by Wootton et al. They can be used with any of the dose tables or graphs which have been published for linear radium sources. (auth)

41685 DAILY DETERMINATION IN ITALY OF BETA RADIOACTIVITY FROM FISSION PRODUCTS IN THE AIR. Comit. Nazl. Energia Nucl., Notiziario, 10: No. 7, 26-9 (July 1964). (In Italian)

The β activity of fission products in the air was measured at ground level on dust samples collected at 32 stations in Italy for March and April 1964. The results, given in pC/m^3 are tabulated. (J.S.R.)

41686 USE OF SOME SYNTHETIC DETERGENTS AS DECONTAMINATING AGENTS. D. N. Zutshi and N. K. Verma. Defence Sci. J. (New Delhi), 11: 28-32(1961).

Studies were made on the effectiveness of synthetic detergents for decontamination of various surfaces from ^{131}I and ^{32}P. The surfaces used were pyrex glass, brass, Al, linoleum, and cemented concrete. Only in the case of the cement surface were the detergents completely ineffective. Data are tabulated. (P.C.H.)

41687 OVARIAN DAMAGE BY ROENTGEN IRRADIATION IN ARTHROSIS DEFORMANS OF THE HIP JOINT—NO FURTHER OBLIGATION TO INFORM THE ALREADY SUFFICIENTLY INFORMED PATIENT. Wolfgang Gelhaar. Deut. Med. Wochschr., 88: 1707-9(Aug. 30, 1963). (In German)

A summary is presented of the German Supreme Court decision reversing the verdict of the lower court in the case of a patient suing a radiologist for alleged ovarian damage due to irradiation in the course of treatment for joint disease. The court held that the radiologist used an acceptable means of treatment then known to medical science and was not negligent in his duties in not pointing out to the patient the possible hazards of the treatment. It was considered that she was sufficiently informed when she sought the treatment and there was no need for using the busy radiologist's time in discussing the matter with her. (BBB)

41688 MEETING ON PROTECTION OF THE POPULATION IN CASE OF ACCIDENTS WITH SUPPOSED RISK OF IRRADIATION. E. Ramos Rodriguez (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 7: 32-4(Apr.-June 1964). (In Spanish)

The proceedings of the Seminar on protection of the population from irradiation resulting from a nuclear incident are summarized. The general program and the titles of the papers presented are tabulated. (J.S.R.)

41689 THE NUCLEAR SHIP AND CIVIL RESPONSIBILITY. Alfonso de los Santos Lasurtegui (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 7: 66-79(Apr.-June 1964). (In Spanish)

The results of a study made by committee of the Permanent Commission under the Convention on the Civil Responsibility of the Operators of nuclear vessels are reported. The committee considered the international jurisdiction of the International Tribunal to define the Convention, the international background of insurance, or the system of mutual guarantees, and intergovernmental organizations that act as "Estados de la Licencia." (J.S.R.)

41690 ADSORPTION OF SHORT-LIVED PRODUCTS OF RADON DECAY ON THE WALL SURFACES OF MINES FROM A TURBULENT AIR STREAM. Yu. T. Kapitanov, A. S. Serdyukova, A. P. Korenkov, and Yu. A. Lebedev (Geological Prospecting Inst., Moscow). Izv. Vysshikh Uchebn. Zavedenii, Geol. i Ravedka, 7: 126-36(1964). (In Russian)

Relations pertaining to the adsorption of ^{218}Po, ^{214}Pb, and ^{214}Bi on the wall surfaces of mines from a turbulent air stream caused by ventilation were studied by using data obtained in mine and laboratory experiments. For the tubes used in laboratory experiments, the rate of the diffusion flow B_1 of radioactive aerosols to the walls (which determine the rate of deposition of Ra isotopes) is described by the formula: $Bi = D^{3/4} C_0 \cdot Re^{7/8} v^{1/4} / 38R$, where D is the diffusion coefficient of the aerosols in air, C_0 their concentration in air, v the kinematic viscosity of air, and R the tube radius. Satisfactory agreement between calculated values and those determined at the mine were obtained. No adsorption of ^{214}Bi was found in several determinations at the mine. Adsorption of ^{214}Bi presumably reached an equilibrium value limited by a recoil effect arising in connection with the decay of ^{214}Pb to ^{214}Bi. The concentration of dust in the air of the mine was not taken into consideration. Mine bracings of stone, Fe, wood, and concrete adsorbed the Ra isotopes to an approximately equal extent. (P.C.H.)

41691 COSMIC RADIATION DOSE IN SPECIALLY INSTALLED BIOLOGICAL BLOCKS IN VOSTOK-3 AND VOSTOK-4 SATELLITES. V. N. Lebedev, V. S. Morozov, G. F. Murin, M. D. Nikitin, and M. I. Salatskaya. Kosmich. Issled., 1: 309-11(Sept.-Oct. 1963). (In Russian)

Cosmic radiation doses were measured using nuclear emulsions, scintillation dosimeters, and x-ray films in special biological blocks. The average dose measured in Vostok-3 was 41 ± 6 mrad and in Vostok-4, 30 ± 4 mrad. (tr-auth)

41692 REMOVAL OF RADIOCESIUM FROM BEEF. Gerald D. Gernon, Jr. (Univ. of Tennessee, Knoxville) and M. C. Bell. Nature, 203: 1189-90(Sept. 12, 1964).

Distribution of radiocesium in food is discussed, and findings are reported that indicate radiocesium is accumulated more abundantly in muscle than in other body tissues. Data are also reported on the removal of radiocesium from raw beef muscle of a heavy steer that had received a 10 Mc dose of ^{134}Cs intravenously. (H.M.G.)

41693 COMPARISON MEASUREMENTS OF LONG-LIVED TOTAL BETA ACTIVITY OF THE AIR IN TWO DIFFERENT ALTITUDES IN THE ALPS. Gertrud Keck and Ami Zwi Nathan (Tierarztliche Hochschule, Vienna). Naturwissenschaften, 51: 332-3(1964). (In German)

From June to October 1963 comparison samples were obtained on 79 days at a valley station (1041 m altitude) and a mountain station (2348 m altitude). The usual methods were used for the concentration of the atmospheric dusts on filters and for the measurement of the long-lived β activity. The daily values of the total β activity showed sharp fluctuations, which were at least synchronous in the two stations. On 53 days, the air activity at the mountain station was larger than at the valley station, the same on 4 days, and smaller on 22 days. A mean value of the 79 samples gave an increase of the long-lived β activity of the air with increasing altitude of about 16 ± 1% for a height difference of 1307 m. (J.S.R.)

41694 RADIOACTIVE HAZARDS AND THE PUBLIC HEALTH SERVICE. D. G. Arnott (London Hospital). Public Health, (London), 75: 195-203(May 1961).

The sources of occupational and incidental exposure to ionizing radiations and radioactive substances are considered, and legislative regulations which have been developed in Britain are outlined. The hazards of the transportation of radioactive materials are discussed in detail. The danger here is in accidents, the nature of which it is difficult to forecast and against which it is impossible to provide 100% adequate protection in advance. It is predicted that this hazard will grow; since by the mid 1960's about 5% of the electricity in the United Kingdom will be generated by fission power. This will necessitate increasing transport of highly radioactive spent fuel elements to Windscale for processing. Spent fuel elements from the nuclear power stations will be carried as far as possible by rail. Regulations for railroad, sea, and air transport are described. Disposal of radioactive waste, a problem concerned most in the processing of irradiated fuel elements, is also considered, as are the hazards of nuclear test explosions. Present estimates of stratospheric residence time of fallout is very much less than originally thought. The earlier estimate of 7 to 10 yr was the basis for the estimates of the incidence of leukemia, osteogenic sarcoma, and genetic injury which might accrue as the result of bomb testing programs. However, toward the end of 1959 it became clear that the level of radioactivity in the atmosphere is less than was to be expected on the 7 to 10 yr hypothesis. The present and proposed laws regarding radiation protection in the United Kingdom are reviewed. (BBB)

41695 NUCLEAR PLANTS AND SAFETY. F. Cambi. Riv. Ing., No. 8, 861-72(Aug. 1963). (In Italian)

Industrial aspects of nuclear plants are discussed. Causes of personnel exposure to ionizing radiation and sources of hazard are considered. Harmful effects of ionizing radiation and research on them are described. Statistical data issued by the United States Atomic Energy Commission concerning accidents and exposure levels in a limited number of cases are reviewed. Accidents resulting from the Pacific tests, consequences of a reactor excursion, automatic safety controls, technical factors on which present safety studies are based are discussed. (UKAEA)

41696 MANUAL OF INDUSTRIAL RADIATION PROTECTION. PART IV. GUIDE ON PROTECTION AGAINST IONISING RADIATIONS IN INDUSTRIAL RADIOGRAPHY AND FLUOROSCOPY. Washington, D. C. and Geneva, International Labour Office, 1964. 70p.

Safeguards are presented for the control of radiation exposures in industrial radiography and fluoroscopy. Both open and enclosed installations are considered and shielding calculations are included. Operating conditions and procedures are outlined for the use of x and γ sources. (C.H.)

41697 MANUAL OF INDUSTRIAL RADIATION PROTECTION. PART V. GUIDE ON PROTECTION AGAINST IONISING RADIATIONS IN THE APPLICATION OF LUMINOUS COMPOUNDS. Washington, D. C. and Geneva, International Labour Office, 1964. 56p.

Radiation hazards involved in the use of luminous paints containing Ra, MsTh, ^{90}Sr, tritium, ^{14}C, ^{85}Kr, ^{147}Pm, or ^{204}Tl are discussed. Radiation protection during the application, storage, and handling of radioactive luminous compounds is emphasized and special problems associated with individual nuclides are outlined. It is pointed out that luminizing work areas should be well-lighted, well ventilated, easily cleaned, and provide ample work space. Instruments for use in area monitoring are described. (C.H.)

41698 PUBLIC HEALTH ASPECTS OF PROTECTION AGAINST IONIZING RADIATION. Report Prepared by the WHO Regional Office for Europe on a Conference Convened by the World Health Organization, Düsseldorf, 25 June–4 July 1962. Copenhagen, Regional Office for Europe World Health Organization, 1963. 72p. (EURO-234)

The role of public health services in respect to radiation protection was reviewed. Topics discussed included ionizing radiation as a public health problem; the existing laws, regulations, and codes of practice of the various countries governing radiation protection services; the role of public health radiation services; the role of public health services in planning for and dealing with nuclear incidents and accidents; the qualifications and training of public health personnel in charge of radiation protection services; and education of the public in the field of radiation protection. (C.H.)

41699 RADIOAKTIVNOST' I DOZIMETRICHESKII KONTROL'. (Radioactivity and Dosimetric Control). A. S. Srapionov. Tashkent, Publishing House of the Uzbek Academy of Sciences, 1964. 208p.

Data are given on the atomic theory, structure of nuclei, mechanism of particle reactions with atoms, and processes in nuclei in radioactive transformation. Dosimetric equipment and instrumentation for practical applications are reviewed, and simplified calculational methods are given. (R.V.J.)

41700 RADIOLOGICAL PROSPECTING BY HELICOPTER. APPLICATION IN AN ACCIDENTAL ATMOSPHERIC RELEASE OF FISSION PRODUCTS IN THE MOL AREA. R. Boulenger, X. de Maere, and A. Osipenco. 26p. (CONF-337-8). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

Measurement techniques used for radiological prospecting and the various conclusions drawn from the results obtained in flying over voluntarily contaminated pastures are reported. (P.C.H.)

41701 STUDY OF RADIOACTIVE WASTE FROM THE EL.2 AND EL.3 REACTORS OF THE SACLAY CENTER OF NUCLEAR STUDIES. L. Fitoussi and P. Lebouleux. 21p. (CONF-337-11). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

After a brief introduction on the necessity for the control of radioactivity from the point of release of gaseous effluents from nuclear installations, the air circuits of the EL-2 and EL-3 Reactors and the installations for the measurement of the radioactivity released by these reactors are described. These measurements include γ radiation, gases, radioactive aerosols, and, particularly, ^{131}I. The results obtained during several months of operation are reported, and the different radioisotopes released are defined. The results make possible the evaluation of the practical efficiency of filters for the different radioisotopes. The results are discussed, and simplified solutions for the control of gases released are proposed. (tr-auth)

41702 CONTAMINATION OF THE AIR DUE TO THE ACTIVATION OF ATMOSPHERIC DUSTS EXPOSED TO NEUTRON FLUXES. C. Cortissone, O. Ilari, and N. Stipcic. 26p. (CONF-337-20). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The phenomenon of activation of atmospheric dust exposed to neutron irradiation was examined, and the principal parameters having a qualitative or quantitative effect on the induced contamination were analyzed. The filters through which air was drawn were exposed to a neutron flux of 1.3×10^{12} n/cm^2 sec. The decay of the γ and β radiation was followed, and the γ spectra were analyzed in order to determine the radioactivity that could be induced in atmospheric dust in the vicinity of a neutron channel. The results are graphed and tabulated, and the MPC in the air for continuous exposure of 40 hr/week was determined for the most important radioisotopes identified. (J.S.R.)

41703 STUDY OF THE HYPOTHESIS OF CLEANSING OF THE ATMOSPHERE BY RAIN. 14p. (CONF-337-22). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The effect of precipitations on the natural or artificial contamination of the air near the ground was studied statistically. The relations between the artificial activity of rain and the rain intensity, the artificial activity of the air and precipitations, and the natural activity of the air and the amount of precipitation were investigated. The results showed that rain had no detectable effect on the level of artificial β activity. The more rain there is the less change there is of it having high activity. It is probable that rain had a very sharp cleansing effect on the natural atmospheric activity. (J.S.R.)

41704 GAMMA SPECTROMETRIC ANALYSIS OF RADIOACTIVE PARTICLES FOUND IN FALLOUT OF YEARS 1961-1962. A. Kaul and Th. Franke (Max-Planck-Institut für Biophysik, Frankfurt am Main). 19p. (CONF-337-15). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

Immediately after the resumption of atomic tests in the atmosphere in the autumn of 1961, an increase of the artificial radioactivity of the atmosphere near ground level from an original value of 0.01 to 0.05 pC/m^3 was observed. A decrease of the specific radioactivity of the air was then verified up to the summer of 1962. Beginning with September 1962, a new increase of the artificial radioactivity of the air coming from another series of tests in the autumn of 1962 was observed. With the increase of the radioactivity, the presence of radioactive particles should be established. The particles were collected with an air collector working periodically and were then localized by self-radiography. The analyses of the radioactive particles had the purpose of clarifying the following problems: radioactivity of the particles and their frequency, γ spectrometric composition, and size distribution of the particles and their inactive composition. (tr-auth)

41705 EXPERIMENTS ON ATMOSPHERIC DIFFUSION OF PROPER MAGNITUDE. R. Le Quinio and J. Hugon. 12p. (CONF-337-12). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The experimental method used to study atmospheric diffusion in true magnitudes is described. Uranine is used as the tracer, and the measurement techniques are discussed. The sampling apparatus and its method of operation are also described. A critical evaluation was made of the method. (J.S.R.)

41706 CIRCULATION OF NATURAL AND ARTIFICIAL RADIOACTIVE AEROSOLS IN THE TROPOSPHERE. Gerard Lambert (Centre d'Etudes Nucleaires, Saclay, France). 12p. (CONF-337-18). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The atmospheric concentration of radioactive aerosols at ground level was studied as a function of the season and geographic position of the sampling site. Two different phenomena were observed: those that obey the laws of tropospheric circulation and those that depend on transfers between stratospheric reservoir and troposphere. The latitude distributions of the radioactive aerosols in the few weeks after a nuclear explosion showed the existence of a diffusion barrier in the troposphere in the vicinity of the equator. The radioisotopes detected from April 1960 to August 1961 at ground level originated from the stratospheric reservoir. The highest concentrations were found at mean latitudes of each hemisphere. There was a sharp increase in May-June of both years in the concentration of radioactive aerosols at mean latitudes of the northern hemisphere.

Sharp fluctuations in the radioactivity were detected and correlated with the proximity of a geographic or seasonal maximum. It appeared that the aerosols in the lower stratosphere would be transferred to the troposphere in a discontinuous manner by puffs of very limited duration and dimensions. These would vary with latitude and season, which caused a concentration maximum whose latitude varied with the season. The movement of this maximum towards 40°N coincided with the springtime increase of stratospheric exchanges. (J.S.R.)

41707 DIFFERENTIAL MEASUREMENT OF RADIOACTIVE FALLOUT IN THE VICINITY OF THE GROUND IN PRESENCE OR ABSENCE OF PRECIPITATIONS. A. Doury, C. Caput, and A. Leblond (Commissariat a l'Energie Atomique, Paris). 24p. (CONF-337-25). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The direct measurement of radioactive deposits from the free atmosphere poses sampling problems all the more difficult to resolve because the measurement takes place in a region having large climate variables. A new device, the differential collector of total atmospheric fallout (CODIRAT) was developed to improve previous methods by assuring the automatic differential sampling of precipitated fallout or dry fallout. This result was obtained by using an electrochemical system that includes a precipitation detector that commands the rotation of a pan provided with an adhesive material. The conical bottom of the pan is tilted up to catch precipitations. The first measurements available were not sufficient to formulate valid statistical conclusions. Nevertheless, the comparison of these measurements with traditional measurements obtained simultaneously by previous methods helped formulate some working hypotheses for further studies. It seemed that on the traditionally uncovered adhesive surfaces, the radioactive deposit carried by precipitations was much more than the activity carried away. (tr-auth)

41708 AIR AND GAS CLEANING METHODS FOR REACTOR CONTAINMENT VESSELS. L. Silverman (Harvard Univ., Boston). 25p. (CONF-337-59)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

A survey was made of the existing and some proposed new methods for the control and purification of air and gases that might be released from a reactor contained or confined for protection of the health and safety of the public from potential accidents. The difference between confinement and containment concepts is considered. Safety measures necessary to control the release of radioactive materials to the environment are discussed. (P.C.H.)

41709 STATE OF ELECTRIC CHARGE OF LARGE NATURAL RADIOACTIVE IONS. J. Bricard, J. Pradel, and A. Renoux. 5p. (CONF-337-14). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The existence of large negative radioactive ions is confirmed, and their mode of formation is studied. (J.S.R.)

INSTRUMENTATION

General

Refer also to abstract 41628.

41710 (AL-TDR-64-46) SUPERCONDUCTIVE EFFECTS IN THIN FILMS. S. Shapiro and E. J. McNiff, Jr. (Little (Arthur D.) Inc., Cambridge, Mass.). Mar. 1964. Contract AF33(657)-7915. 83p. (AD-439221)

The feasibility of using the superconductive properties of certain thin film configurations to perform electronic functions is investigated. Particular attention was paid to the phenomenon of electron tunneling between superconductors as exhibited in suitably prepared thin film structures. Stimulated by the extreme non-linearity of the I-V characteristic of a tunneling sample, investigations were carried out involving the use of such samples as detectors and mixers at r-f and microwave frequencies. Detection experiments were carried out at 2 Mc, and the characteristic analyzed successfully by a simple model based upon an equivalent circuit representation of the tunnel structure. Use of a tunneling sample as an r-f oscillator and amplifier by other workers is discussed and comments are made on the suitability of tunneling samples for practical applications. (auth)

41711 (IAE-589) ANALIZ RABOTY TRANZISTORNOGO KASKADNOGO USILITELYA. (Analysis of the Operation of a Transistorized Cascade Amplifier). G. P. Mel'nikov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 8p.

The design is given of a transistorized amplifier using a constant shift transistor as a nonlinear load. The resulting amplification coefficient is about 1500, with 90% voltage supply utilization. The amplifier performs at high linearity, high stability, and 200 μa current. The amplification range is up to 20 kc. (tr-auth)

41712 (IAE-591) SKHEMY S MNOGIMI USTOICHIVYMI SOSTOYANIYAMI NA TUNNEL'NYKH DIODAKH, UPRAVLYAEMYE PO TOKU. (Current-Controlled Tunnel Diode Circuit Having Many Stable States). G. P. Mel'nikov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 8p.

Schemes are given of a chain of tunnel diodes and controlled current sources. The schemes were used for the recalculation of pulses and transformation of pulse amplitudes into discrete magnitudes and for operations of a Schmitt trigger with many stable states. (tr-auth)

41713 (JINR-P-1689) RAZBOR ODNOI SKHEM DLYA MAGNITIYKH IZMERENII. PRI POMOSHCHI DATCHIKOV KHOLLA. (A Description of a Circuit for Magnetic Measurements Using Hall Generators). Yu. Betko, I. Glasnik, M. Polak, and I. Pusyak (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 17p.

A method is described for measuring the magnetic field using Hall generators. The errors in the measurements are analyzed. The results of measurements of the spatial distribution of the magnetic field in magnets are presented. Measurements are made of the gradients of the magnetic fields in lenses. The accuracy of measurements is 0.1 to 0.5%. (auth)

41714 (LA-3100) DESIGN AND OPERATION OF A NEW AUTOMATIC COMPARATOR FOR MEASUREMENT OF SPECTRA. David W. Steinhaus, Rolf Engleman, Jr., and William L. Briscoe (Los Alamos Scientific Lab., N. Mex.). June 1, 1964. Contract W-7405-eng-36. 79p.

An automatic comparator for the rapid and accurate measurement of spectra is described. A list of transmission values at equal intervals along the spectrum plate is made using a precision densitometer with a precision linear comparator. The list is then given to a digital computer along with the formulas relating position to wave number and transmission to intensity. The interval containing each line is found by a technique employing the second differential of the intensity. All the points in this interval are then fitted, by least squares, to a polynomial equation. This equation is then solved for the wave number and intensity of the line. When the line shape is of some known form, such as Gaussian, another least squares procedure can be used to correct for overlapping lines. This least squares procedure gives the wave number, intensity, line width, and the probable error in each quantity. The computer output consists of the wave number, intensity, and shape for each line on: A) a curve, plotting intensity vs position values for the entire spectrum plate, B) a printed paper listing, and/or C) a deck of IBM cards for future use. The program can recognize four line shapes: symmetrical, shaded toward longer wave numbers, shaded toward shorter wave numbers, and wide lines. Also, a coded remark is given to each line located on the edge of a more intense line or with doubtful measured values. Readings on most lines, including dark, weak, wide, asymmetrical, or complex are made as well as can be done by an operator using a photoelectric comparator. Over 200 lines per minute are processed by the computer. A position precision of 0.1 micron was demonstrated for sharp lines 25 microns wide. Examples of the use of this automatic comparator on emission and absorption spectra are given. (auth)

41715 (NP-14281(p.8-32)) ON THE SERIES COMPARATOR METHODS OF MEASURING THERMAL CONDUCTIVITY. M. J. Laubitz (National Research Council of Canada. Div. of Applied Physics, Ottawa).

A method of mathematical analysis of series comparators is outlined, and results of calculations for one particular comparator are presented. It is shown that when the conductivity of the unknown differs significantly from the standard, the comparator gives grossly erroneous results. (auth)

41716 (NP-14281(p.95-154)) THERMAL CONDUCTIVITY MEASUREMENTS BY THE THERMAL-COMPARATOR METHOD. R. W. Powell (Gt. Brit. National Physical Lab., Teddington, Middx., England).

An account is given of the use of the original two-ball form of the thermal comparator for thermal conductivity determinations on solids, liquids, and powders. An analysis of the conditions governing the flow of heat from the ball to a plane test surface shows the temperature at the point of contact to be quickly established, to change relatively slowly with time, and to be a function of the thermal conductivity of the test material. A thermal comparator based on the measurement of this contact temperature would be direct reading and independent of load and surface finish. Two such direct-reading thermal comparators are described and have given useful results although the temperature so far measured departs from that of the contact and surface finish. Much smaller specimens can however be tested before the reading becomes size dependent.

Results are given for several ceramic and semiconducting materials, and the new method is considered particularly suitable for comparative thermal conductivity determinations on samples of such materials for which this property often varies considerably from sample to sample. (auth)

41717 (ORNL-3687) PERFORMANCE CHARACTERISTICS OF MODULAR NANOSECOND CIRCUITRY EMPLOYING TUNNEL DIODES. N. W. Hill, R. J. Scroggs, J. W. McConnell, and J. M. Madison (Oak Ridge National Lab., Tenn.). Oct. 1964. Contract W-7405-eng-26. 40p.

Tunnel diodes were used in the design and construction of a variety of modular circuitry used in instrumentation for high-energy particle experiments. Modules included fast- and slow-recovery discriminators, fast- and slow-recovery coincidence modules, positive- and negative-output scaler drivers, and a 100-Mc scaler driver. The individual univibrators used in the circuitry and the completed modules were subjected to extensive tests to determine the effects of variations in operating temperature and in input pulse magnitude on resolution, pulse shape, walk, and thresholds. It was found that circuitry using tunnel diodes is strongly affected by such variations, as well as by fluctuations in the power supply. It was also noted that parameter differences between supposedly identical tunnel diodes produced significantly large variations in module behavior. It is concluded that the modular circuits discussed and shown are satisfactory for their intended purposes, but that maximum performance and stability can be assured only by individual selection and testing of the tunnel diodes and by regulation of power supplies to ±0.01% for both line and load. Some general details of the construction of the modules are given. (auth)

41718 (ORNL-P-227) SMOOTHED THERMOCOUPLE TABLES. E. G. Davisson and R. K. Adams (Oak Ridge National Lab., Tenn.). [July 27, 1964]. Contract [W-7405-eng-26]. 30p. (CONF-701-1)

From Instrument Society of America 19th Annual Instrument-Automation Conference and Exhibit, New York, Oct. 1964.

Since the rounding error associated with the present standard tables for thermocouple emf-versus-temperature is too large to allow the use of these tables for precision thermometry, smooth tables expressed to a significance of 0.001 microvolt, which match the NBS Circular 561 tables everywhere to within the NBS rounding, were obtained. The method and mathematical techniques for preparing the tables and the results are described. The address is given where punched card copies of the smoothed tables may be obtained. (auth)

41719 (SCL-DC-64-57) THE USE OF TUNNEL DIODES TO RECORD THE PEAK VOLTAGE OF AN APERIODIC PULSE. Paul A. Lux (Sacramento State Coll., Calif.). [Apr. 1964]. Contract AT(29-1)-789. 12p. (CONF-501-1)

From Western Electric Show and Conference and IEE Summer General Meeting, Los Angeles, Aug. 1964.

Analog simulation was used to study the switching characteristics of a simple series tunnel diode string (6 members). Rise-times and recovery were investigated. (R.E.U.)

41720 (UCRL-7533) SINGLE-CYCLE FUNCTION GENERATOR. D. H. Liston (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 4, 1963. Contract [W-7405-eng-48]. 3p.

A system capable of producing any shape signal that can be set up on the oscilloscope screen is described. The gating circuitry of an oscilloscope is used to trigger a transistor switch to produce a single cycle of a periodic function. A positive or negative signal of 10 volts zero-to-peak maximum may be generated. (R.E.U.)

41721 (UCRL-11048) WATER-COOLED HEATSINKS FOR HIGH-CURRENT SCR'S. Everett L. Harris, Jr. (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 4, 1963. Contract W-7405-eng-48. 20p.

The design and performance of a water-cooled heatsink for a 110-amp SCR (2N1911) operating with a 10°C rise at the stud are described. The effects of water flow-rate and method of mounting were studied. (R.E.U.)

41722 (UCRL-11472) A LINEAR ELECTRONIC SWEEPING PULSE GENERATOR. Lloyd B. Robinson and Fong Gin (California. Univ., Berkeley. Lawrence Radiation Lab.). June 1, 1964. Contract W-7405-eng-48. 43p.

An instrument is described that is useful for setting up and testing complex electronic pulse-handling systems. The instrument provides pulse up to ±10 v into a 125-ohm line at regular or random rates up to 10^6 pps. The pulse amplitude can be electronically swept through the whole amplitude range in a time-wise linear fashion, with periods from 0.5 msec to 20 seconds. Rise times from 0.05 to 1 μsec can be obtained. The pulses can either be flat-topped or have exponential tails from 5 to 100 μsec. A completely d-c-coupled output is provided for reliable measurements of rate-sensitive effects in pulse amplifiers and analyzers. The instrument can also be used as a time-to-amplitude converter for times greater than 5 μsec. (auth)

41723 (UJV-987/64) RADIAČNÍ STABILITA TERMOČLÁNKŮ. I. ČÁST. (Radiation Stability of Thermocouples. Part I.). M. Krohová and I. Saxl (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1962]. 12p.

Theories are given of the change of the thermoelectric force due to the influence of disorders (interstitials and vacancies) induced by the irradiation of the metals with a flux of charged particles and neutrons based on an approximation of the free electron, and research on experimental notions concerning this problem is reported. It is concluded that the change of the thermoelectric force by irradiation is considerably greater in irradiations at low temperatures (50-100°K). At higher temperatures the recovery process proceeds simultaneously; consequently the damage is less. For a flux of 10^{20} n/cm^2 the change in the thermoelectric force for the couples iron–constantan, chromel–alumel, copper–constantan is about 3-6 × 10^{-7} v/°C. Since even at temperatures above 400°C the radiation damage in such materials is fully annealed, one can assume that the greatest error in thermocouple data will occur in measurements around 400°C, namely about 3-5°C for a flux of 10^{20} n/cm^2. If a thermocouple has been exposed to a flux of 10^{20} n/cm^2, it can again be used with its original precision if it is first heated for several hours at 500-600°C. (TTT)

41724 (WAPD-T-1708) SMALL DISPLACEMENT, SELF-BALANCING DIFFERENTIAL MANOMETER. W. H. Bell (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 1964. Contract AT-11-1-GEN-14. 7p. (CONF-674-1)

For presentation at Joint Automatic Control Conference, Troy, N. J., June 1965.

A self-balancing liquid servomanometer has been designed and successfully used to measure pressure drops of 0.02 in. to 100 in. of virtually any manometer fluid at static pressures up to 2,500 psi. This manometer is capable of following more rapid changes in pressure drop than can be followed by conventional servo liquid manometers because of a design feature which minimizes the quantity of the fluid that must be drawn from the process while the instrument is assuming a new balance point. Tests conducted with carbon tetrachloride and water as the manometer and system fluids respectively showed that the manometer could balance within one minute after a step change in pressure drop has occurred even when the lead lines contained 50 feet of 0.040 in. ID tubing. This compares to a balancing time of many hours for a conventional U-tube manometer filled with carbon tetrachloride. (auth)

41725 (ANL-Trans-78) RO AND ZEBRA. MEASUREMENT OF DEAD TIME IN PULSE ELECTRONICS. Rolf Persson (Aktiebolaget Atomenergi, Stockholm). Translated for Argonne National Lab., Ill., from report TPM-RFX-103. Jan. 6, 1961. 5p.

The dead time was measured using three channels and pulses from two counters. The intensities from the pulse counters initially pass directly each into its own channel, then they are mixed in a special stage and pass into the third channel. Each channel includes a main amplifier, scales, and recorders. (R.E.U.)

41726 (SLAC-Trans-8) WIDE-RANGE PANORAMIC WAVEMETER. S. P. Kapitsa and N. I. Kondrat'ev. Translated for Stanford Univ., Calif., from p.119-21 of "Elektronika Bol'shikhmoshchnostei" (a publication of the Publishing House of the Academy of Sciences, USSR, Moscow, 1963). 6p.

A description is given of a panoramic wavemeter that provides for observation of the spectrum of continuous h-f oscillations in a wide range of wavelengths. The scanning on an oscilloscope screen corresponds to the band of wavelengths up to 12 cm; the range of measurements lies between 5 and 50 cm. (R.E.U.)

41727 (SLAC-Trans-9) MEASUREMENTS OF SUPERHIGH FREQUENCY WITH RECORDING ON GRAPH PAPER. S. P. Kapitsa, N. I. Kondrat'ev, and Yu. M. Petrusevich. Translated for Stanford Univ., Calif., from p.122-32 of "Elektronika Bol'shikhmoshchnostei" (a publication of the Publishing House of the Academy of Sciences, USSR, Moscow, 1964). 19p.

A method for obtaining results of high-frequency measurements in the form of recordings on graph paper is described. The method is convenient for subsequent processing of the measurements taken. Examples of recordings of resonance curves and of obtaining frequency markers by utilizing the heterodyne frequency meter are given. A wide-range wavemeter with a direct reading of the wavelength is described. (auth)

41728 ADVANCES IN X-RAY ANALYSIS. VOLUME 7. Proceedings of the Twelfth Annual Conference on Applications of X-Ray Analysis Held August 7-9, 1963. William M. Mueller, Gavin Mallett, and Marie Fay, eds. Advan. X-Ray Anal., 7: 1-662(1964). New York, Plenum Press, 1964. $22.50. (CONF-174)

Fifty-three articles are included; separate abstracts were prepared for 2. Eleven articles on relation between ionic radii and transformation temperature in rare earth niobates, determinations and descriptions of preferred orientation, microstructures in the Ta–C system, x-ray diffractometry of single crystal strontium titanate, preferred orientation in ceramic materials due to forming techniques, x-ray absorption method for elemental analysis, interrelations of sample composition, backscatter coefficient, and target current measurement, interdiffusion of Nb alloy with type 316 stainless steel, experimental dispersing devices and detection systems for soft x rays, application of pulsed soft x-ray system to the determination of phosphor response characteristics, and determination of Th in monazite by fluorescent x-ray spectrometry were previously abstracted in RDA as 8: 500 and NSA as: 17: 34413, 37499, 40761; 18: 1595, 2097, 8392, 8635, 12113, 22162, and 22521. The remaining articles were determined not to be in scope for NSA. (P.C.H.)

For abstracts of individual papers see: 41381 and 41729.

41729 A VERTICALLY ROTATING DOUBLE-CRYSTAL X-RAY SPECTROMETER. M. C. Wittels, F. A. Sherrill, and A. C. Kimbrough (Oak Ridge National Lab., Tenn.). Advan. X-Ray Anal., 7: 265-80(1964). (CONF-174-4)

A versatile double-crystal x-ray spectrometer was developed for the precise measurement of x-ray diffraction line widths to tenths of seconds. The device can be employed in either the parallel or antiparallel arrangement for rocking curve studies and can also be used in anomalous x-ray transmission experiments with nearly perfect crystals. A detailed description of the instrument is given as well as some results concerning the Darwin theory of x-ray diffraction line widths and Borrmann effects. (auth)

41730 A VERSATILE FREQUENCY DIVIDER. J. H. Thorngate (Oak Ridge National Lab., Tenn.). Health Phys., 10: 687-9(Sept. 1964).

A transistorized frequency divider that provides output pulse rates of 60/sec, 10/sec, 100/min, and 100/hr from an input of 60 c/sec at 3 v is described. The divider will operate with input frequencies or random pulses up to 5×10^5 $\sec^{-1}$ and will divide by 2 through 8, depending upon the application of input and feedback. Negative pulses can also be handled. (D.C.W.)

41731 SMALL-DIMENSIONAL MASS SPECTROMETERS USED IN THE INVESTIGATION OF NEUTRAL AND IONIZED GASES IN UPPER ATMOSPHERE. V. A. Pavlenko, A. E. Rafal'son, and M. D. Shutov. Kosmich. Issled., 1: 287-95 (Sept.-Oct. 1963). (In Russian)

A short review is given of the theory of r-f mass analyzers. The scheme and construction of three r-f mass spectrometers designed for measuring ion and neutral compositions of the upper atmosphere are described. (R.V.J.)

41732 A LIGHT-INTENSITY MONOCHROMATOR FOR INVESTIGATION OF SMALL-ANGLE SCATTERING OF X RAYS. Gregor Damaschun (Universität, Jena, Ger.). Naturwissenschaften, 51: 378-9(1964). (In German)

Apparatus for obtaining a monochromatic beam of x rays practically without intensity loss is described. The principles of the frame camera with the total-reflection monochromator are discussed and a diagram included. Advantages of the total-reflection monochromator over the crystal monochromator in combination with the Kratky geometry are outlined. (M.C.G.)

41733 A MULTIPLE INPUT COUNTING STATION WITH CENTRAL CORE MEMORY. R. J. Pecina (Argonne National Lab., Ill.) and W. Weidemann. Nucl. Instr. Methods, 27: 285-91(July 1964).

An approach to the problem of multiple-channel scaling systems is described. The use of a fast central core memory, which is shared by the various channels, results in significant savings in complexity, cost, and space. (auth)

41734 THEORETICAL AND EXPERIMENTAL STUDY OF A FAST INTEGRAL DISCRIMINATOR. J. Winter (Central Bureau for Nuclear Measurements, Geel, Belg.). Nucl. Instr. Methods, 28: 229-36(Aug. 1964).

The tunnel diode univibrator is calculated in detail, and its switching cycles are obtained by a graphical integration of its differential equation. An integral discriminator with a measuring range from 0.1 to 2.5 v and a constant time resolution of 13 nsec is described. (auth)

41735 FAST TRANSISTORIZED TIME TO AMPLITUDE CONVERTER. D. Ophir (Israel Inst. of Tech., Haifa). Nucl. Instr. Methods, 28: 237-41(Aug. 1964).

A solid-state time-to-pulse amplitude converter with a linear range of 25 nsec and a time resolution of 0.5 nsec is described. The switching elements are fast transistors and tunnel diodes. The circuit storage element is a current charged coil. (auth)

41736 A PHASE DETECTOR AT 110 MHz. R. Arnal and G. Beuchot (Institut National des Sciences Appliquees, Villeurbanne, France). Nucl. Instr. Methods, 28: 277-8 (Aug. 1964). (In French)

A phase detector accurate up to 110 Mcps is described. A square-wave generator is used which, by blocking transistors just at the limit, provides rapid deblocking. (auth)

41737 A TRANSISTORIZED TIME-TO-PULSE HEIGHT CONVERTER AFTER A SAMPLING METHOD. D. Bloess and F. Muennich (Technische Hochschule, Brunswick). Nucl. Instr. Methods, 28: 286-92(Aug. 1964). (In German)

A transistorized time-pulse height converter was developed, in which the sampling method is applied. The internal time resolution depends on the linearity range chosen; for a range of 70 nsec, it is 0.1 nsec. The linearity range can be altered easily by using different charging capacitors; therefore, the converter works as well in the msec as in the nsec region. A high stability against temperature drifts was reached by consequently applying the differential amplifier principle. As an example of the performance of the instrument the half life of the 80 kev-level of ^{133}Cs was measured; the experimental value 6.25 ± 0.05 nsec is in excellent agreement with previous results. (auth)

41738 A 100 MHz DIGITAL TIMING SYSTEM. J. K. Whittaker (Atomic Energy Research Establishment, Berks, Eng.). Nucl. Instr. Methods, 28: 293-305(Aug. 1964).

A timing system with a channel width of 10 nsec is described. The equipment is compatible with a digital magnetic tape recording system, but may be used independently. Measurements of the complex energy spectra of photoneutrons from the reactions $^{32}\mathrm{S}(\gamma,n)^{31}\mathrm{S}$ and $^{28}\mathrm{Si}(\gamma,n)^{27}\mathrm{Si}$ are presented, which demonstrate the resolution and linearity of the system. (auth)

41739 AN ALL SOLID STATE NANOSECOND TIME ANALYZER USING AVALANCHE TRANSISTOR SHAPERS. J. J. Samueli, J. Pigneret, and A. Sarazin (Institut de Physique Nucleaire, Lyon). Nucl. Instr. Methods, 28: 330-2(Aug. 1964).

A solid-state time analyzer using avalanche transistor shaping units is described, which features energy independence of the time scale and good overload characteristics. The range of the analyzer is about 20 nsec. The long time stability is better than 4×10^{-11} sec per day; and the resolution time, defined as the full width at half maximum of the resolution curve, is 7.0×10^{-10} sec for ^{22}Na annihilation radiation with 56 AVP photomultipliers and 1.5 × 1.5 in. plastic scintillators and 4.8×10^{-10} sec for ^{60}Co. (auth)

41740 A PRECISION REGULATED TRANSISTORIZED HIGH VOLTAGE SUPPLY. I. Izumi and M. Kokubu (Mitsubishi Atomic Power Industries Inc., Omiya, Japan). Nucl. Instr. Methods, 28: 349-52(Aug. 1964).

A transistorized high-voltage (300 – 1500 v) regulator is described. In order to improve the frequency response of feedback loop gain, a high-frequency bypass loop is used instead of increasing carrier frequency. The characteristics of the instrument are as follows: regulation better than 0.01% for ±10% main voltage variation, internal resistance less than 100 Ω, output ripple less than 1 mv rms, transient recovery time less than 20 μsec, temperature stability better than 0.001%/°C, long-term stability better than 0.01%/day. (auth)

41741 MULTIPLE-INPUT BINARY COUNTERS WITH FEEDBACK. G. Bendiscioli (Università, Pavia, Italy and Istituto Nazionale di Fisica Nucleare, Pavia, Italy). Nuovo Cimento (10), 33: 1698-1704(Sept. 16, 1964).

A study of binary counters with feedback in which the count pulses can command more than one flip-flop of the cascade (or only one but not necessarily the first) was made. After development, the considerations are applied to the case of quinary and decimal counters. The existence of counter-pairs is pointed out thereby making feasible the construction of reversible counters in which forward and backward counts may be obtained simply by the change of the count pulse inputs. (auth)

41742 NEGATIVE FEEDBACK CURRENT INTEGRATOR (TYPE AL2B). R. Bosshard and E. Hubert (Laboratoire de l'Accelerateur Lineaire, Orsay, France). Onde Elec., 44: 493-4(May 1964). (In French)

A feedback current integrator that accepts current from 10^{-6} to 10^{-13} amp is described. In the determination of the charge, the absolute error is less than 0.25% up to 10^{-11} amp and approaches 1% near 10^{-13} amp for continuous operation of several days. This stability was obtained by the use of a vibrating condenser modulator that has a low drift and is insensitive to overloads produced during the integrator cycle. The circuits composing the integrator are transistorized. (J.S.R.)

41743 HIGH-SPEED LINEAR GATE. A. Muser, J. Ruscher, J. Zen, and R. Armbruster (Centre de Recherches Nucleaires, Strasbourg and Institut de Recherches Nucleaires, Strasbourg). Onde Elec., 44: 516-19(May 1964). (In French)

A symmetric linear gate having a rise time of 0.5 nsec and using six semiconductor diodes is described, and its linearity is calculated. The release circuit of the gate is also described, and other gate characteristics are summarized. (D.C.W.)

41744 TRANSMISSION LINE TRANSFORMERS FOR HIGH-SPEED PULSES. A. Muser, J. Zen, and R. Armbruster (Centre de Recherches Nucleaires, Strasbourg). Onde Elec., 44: 520-9(May 1964). (In French)

The equivalence of a transmission line and a perfect transformer is shown, and the frequency limitations of transmission-line transformers are established. Design procedures for pulse line transformers are outlined. The circuits of inverter, isolator, impedance, and symmetrical transformers are illustrated, and some design calculations are summarized. (D.C.W.)

41745 NOTE ON THE ASSOCIATION TUNNEL DIODE-TRANSISTOR. R. Berland and R. Borchi (Institut National des Sciences Appliquees, Villeurbanne, France). Onde Elec., 44: 530-2(May 1964). (In French)

Methods for adapting the characteristics of tunnel diodes and transistors for use in fast logic circuits are described. The factors guiding the selection of the circuit elements are given. Bistable elements and shaping circuits are described, together with their characteristics. (J.S.R.)

41746 SHORT PULSE GENERATORS OF HIGH REPETITION RATE. A. Boyer and L. Frecon (Institut National des Sciences Appliquees, Villeurbranne, France). Onde Elec., 44: 533-4(May 1964). (In French)

A design is proposed for generators producing pulses of 4 to 20 nsec at frequencies of 10-80 Mcps. The basic generator is described, as well as its modification to a pulse voltage generator. (D.C.W.)

41747 MULTIPARAMETER ANALYZER. G. André, P. Antoine, J.-C. Artiges, et al. (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). Onde Elec., 44: 535-43(May 1964). (In French)

The multiparameter analyzer of the Joliet-Curie Laboratory of Nuclear Physics is described. It consists of a converter and computer. The converter transforms the physical data (amplitude, angle, time, etc.) into a code word of 26 digits. The memory block regulates the statistical flow of information, and the computer processes the information. The characteristics and performance of the various components of the analyzer are described. (J.S.R.)

41748 UNIVERSAL POWER CALIBRATING DEVICE. K. A. Yakovlev, Yu. G. Basin, D. K. Pankrushina, N. G. Kovalenko, and V. P. Bezruk (Inst. of Physics and Tech., Erivan). Pribory i Tekhn. Eksperim., No. 4, 111-16(July-Aug. 1964). (In Russian)

An apparatus is described which indicates peak values and permits the observation of oscillograms of pulses of active power, current, and voltage in a load with parameters arbitrarily varying with time. Two varieties of the apparatus have a frequency range of 0.2 to 2 and 1 to 10 Mc. Measurements were carried out for load current of 50 to 1000 amp and voltage of 2 to 20 kv (amplitude values). The width of the frequency spectrum of measured power was from 0 to 15 kc for the first variety and for 0 to 60 kc for the second. The deviation of the measurements is not greater than 10%. The block scheme and circuit diagram of the apparatus are given. (tr-auth)

41749 METHOD TO INCREASE THE PRESSURE DROP ACROSS A DIFFERENTIALLY PUMPED GAS CANAL. H. Winkler (California Inst. of Tech., Pasadena). Rev. Sci. Instr., 35: 1599-1600(Nov. 1964).

An arrangement to increase the pressure drop across a differentially pumped canal, as used in open gas targets for nuclear spectroscopy, is described. By using the momentum of the mass flow of the gas feed into the gas target to build up an additional pressure difference on the high pressure side of the canal, the apparent conductance of the canal can be decreased. Then for equal mass flow through the canal, a higher target pressure can be obtained. (C.E.S.)

41750 REGULATED HIGH VOLTAGE POWER SUPPLY/Q-2077/(Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-875)

Seven drawings are presented for three corona-regulated, transistorized power supplies providing d-c outputs of 900 v at 20 μamp, 1200 v at 2 μamp, and 1400 v at 2 μamp from d-c inputs of 12 v at 11, 8.5, and 7.5 mamp, respectively. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

41751 NUCLEAR INSTRUMENT MODULES (Engineering Materials). (Argonne National Lab., Ill.). (CAPE-1189)

Drawings (15) are presented for physically and electrically (with respect to power supply) interchangeable module systems. The two standard module heights are 5.25 and 8.75 in. The modules slide into bins mounted in EIA standard 19-in. racks. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

41752 GALVANOMETER PEDESTAL-LARGE (Engineering Materials). (Sandia Corp., Albuquerque, N. Mex.). (CAPE-1135)

Drawings (14) are presented for a pedestal which isolates light-beam galvanometers from vibrations to a degree that permits use of sensitive galvanometers at distances of 4m from their scales. Two flat steel plates are suspended by diagonal tension springs between a steel frame and the corners of the lower plate. Four oil-filled dash-pots positioned between the floor of the frame and the lower plate dampen any motion imparted to the mass. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

41753 MEASUREMENT OF SURFACE DENSITY OF PAVING BY BACK-SCATTERED GAMMA RAYS. M. B. Fallgatter (Shell Development Co., Emeryville, Calif.). New York, Instrument Society of America, 1964, Preprint 2.4-3-64, 8p. (CONF-701-6)

From Instrument Society of America 19th Annual Instrument-Automation Conference and Exhibit, New York, Oct. 1964.

A collimated beam of gamma radiation from a radioisotope source is back-scattered at low angles from the surface layers of a material such as paving, to determine density. The apparatus traverses the pavement, but is normally used for spot testing rather than continuous scanning. Density can be measured to better than 1% accuracy under suitable conditions. The scope and limitations of the method are discussed, and a pavement tester is described. It uses a 1-C ^{137}Cs source, an ionization chamber, and battery-operated electrometer. (auth)

41754 IMPROVEMENTS IN OR RELATING TO TEMPERATURE MEASURING METHODS. Wellesley Ashe Kealy and Richard Smart (to United Kingdom Atomic Energy Authority). British Patent 969,917. Sept. 16, 1964. Filed Aug. 11, 1961.

A method is given for measuring the temperature of fuel elements in a reactor. The method comprises heating a magnetic probe, initially at the temperature being measured, by an electric current to its Curie point, and recording the electrical energy as a measure of the temperature. (D.L.C.)

Radiation Detection

Refer also to abstracts 41309, 41625, 42629, 41656, and 42772.

41755 (AD-600253) RESEARCH INVESTIGATION OF p-i-n ELECTRON JUNCTION DETECTORS. Summary Engineering Report, February 11, 1963-April 11, 1964. (Hughes Aircraft Co. Hughes Research Labs., Malibu, Calif.). May 1964. Contract Nobsr 89169. 53p.

Various types of radioactive sources containing the isotopes thallium-204, phosphorous-32, and sulfur-35 have been utilized in carefully specified geometries for the purpose of comparing the response of silicon lithium-drifted p-i-n junction detectors with extrapolation chamber measurements of the surface absorbed dose rate in polystyrene. Specifically, data have been obtained showing the ratio of detector response (open-circuit voltage or count rate) to surface absorbed dose rate in polystyrene as a function of distance from the source for various source and detector areas for both thick and thin sources. "Infinitely thick" solutions of thallium-204 and phosphorous-32 having circular areas of 1.04, 10.0, and 100 sq. cm and "thin" dry (7.6 sq cm area) sources of all three isotopes were used. Detector open-circuit voltage measurements were made for all these source configurations using a number of moderately thin window p-i-n junction detectors having areas of 0.04, 0.24, 1.0, and 11.9 sq cm. One of these detectors (0.24 sq cm) has been used for count rate measurements with all of the thick source configurations. The large (11.9 sq cm) detector was used only with the 10.0-sq cm-thick phosphorous-32 source. Further measurements are now in progress. For all of the detector and source configurations studied, the response of the p-i-n detectors relative to absorbed dose rate increased with distance between source and detector. (auth)

41756 (AERE-R-4677) AN ASSOCIATIVE PULSE ANALYSER FOR NUCLEAR PHYSICS WITH 10^6 CHANNEL RESOLUTION. I. N. Hooton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1964. 28p.

Methods of achieving associative storage, as applied to pulse analyzers, are discussed. General performance requirements are discussed for a system to handle experimental data such as coincidence spectra where the possible range of descriptors is very great, e.g., 10^6 for 1000 × 1000 resolution, while the number of different descriptors is relatively small. (R.E.U.)

41757 (BNL-877) REPORT ON THE LOGICAL DESCRIPTION OF THE SPARK CHAMBER READER. George Schwender (Brookhaven National Lab., Upton, N. Y.). June 1964. Contract AT-30-2-GEN-16. 64p.

The spark chamber reader for scanning 35-mm film and recording the data on magnetic tape is described. (R.E.U.)

41758 (BNL-8309) THE BROOKHAVEN NATIONAL LABORATORY 80-INCH LIQUID HYDROGEN BUBBLE CHAMBER. J. E. Jensen (Brookhaven National Lab., Upton, N. Y.). July 16, 1964. Contract AT-30-2-GEN-16. 24p. (CONF-554-9)

From Cryogenic Engineering Conference, Philadelphia, Aug. 1964.

A description is presented of the newest and largest liquid-hydrogen bubble chamber facility to be placed in operation recently. The description covers all of the basic design parameters of the chamber including special material requirements and buildings. A review of the first year of operation is given, with emphasis on equipment performance. Data such as cool-down rate, refrigeration requirements (static and dynamic), and temperature stability and equilibrium are presented and discussed. (auth)

41759 (BNL-8327) EXPERIMENTAL EXPERIENCE WITH A HIGH CAPACITY DIGITAL DATA HANDLING SYSTEM FOR COUNTER HODOSCOPES AND DIGITIZED SPARK CHAMBERS WITH ON-LINE COMPUTER IN AGS EXPERIMENTS. K. J. Foley, R. S. Gilmore, R. S. Jones, S. J. Lindenbaum, W. A. Love, S. Ozaki, E. H. Willen, R. Yamada, and L. C. L. Yuan (Brookhaven National Lab., Upton, N. Y.). [July 1964]. Contract [AT(30-2)-Gen-16]. 17p. (CONF-550-59)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The characteristics of operation of the system for small-angle scattering experiments using the AGS are reported. (R.E.U.)

41760 (BNL-8378) PORTABLE IONIZATION CHAMBER VIBRATING CAPACITOR ELECTROMETER. J. F. Jacobs (Brookhaven National Lab., Upton, N. Y.). Mar. 20, 1964. Contract AT-30-2-GEN-16. 15p.

A battery-powered electrometer for use with a 3- to 5-liter ionization chamber is described. Continuous analog output recorded on a strip chart recorder and digital output on paper tape are included. The vibrating capacitor, amplifier, synchronous rectifier, and polarity sensor are described. (R.E.U.)

41761 (CEA-R-2443) DOSIMETRIE DU RAYONNEMENT COMPLEXE DE PILE PAR UNE TECHNIQUE CALORIMETRIQUE. COMPLEMENT A LA THEORIE ET INTERPRETATION DES RESULTATS EXPERIMENTAUX. (Complex-Pile-Irradiation Dosimetry Using Calorimeters. Complement to Theory and Interpretation of Experimental Results). Jean de Goer, Pierre Mas, Paul Sciers, and Yves Droulers (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). July 1964. 50p.

Theory, applications, and experimental study of isothermal calorimeters developed at CEN-GRENOBLE were reported in CEA-R-2217 (1962). Since, new data about specific heat of graphite and a complement to theory, brought us to introduce a corrective factor in the fundamental relation: energy deposition versus calorimeter heating. Energy deposition can now be estimated with an accuracy of ±2%, while before there was a systematic error in excess of 2 to 4%. A system of curves permits direct reading of absorbed thermal power versus equilibrium temperature of calorimeter. These curves are available for the two devices TM and TMS used at the CEN-GRENOBLE. (auth)

41762 (CEA-R-2491) MESURE DES FLUX DE NEUTRONS THERMIQUES INTERMEDIAIRES ET RAPIDES AU MOYEN DE DETECTEURS PAR ACTIVATION. (Thermal, Intermediate and Fast Neutron Flux Measurements using Activation Detectors). Jacques Brisbois, Michel Lott, and Georges Manent (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Aug. 1964. 107p.

The problem of neutron flux measurements using activation detectors is studied in the particular case of protection research. It is shown how it is possible, using a known thermal flux, to organize a coherent calibration system for all the detectors. The fast-neutron detectors are calibrated with respect to a reference detector (phosphorus) in a natural uranium converter; the intermediate neutron detectors with respect to gold in the axial channel of ZOE. This method makes it possible to minimize the errors due to the activation cross sections. A description is given of the counting room of the Pile Safety Study Service, as well as the practical utilization characteristics of the counters employed. (auth)

41763 (CONF-550-84) ON-LINE MONITORING OF BUBBLE CHAMBER MEASUREMENTS BY SMALL COMPUTERS. Horace D. Taft and Peter J. Martin (Yale Univ., New Haven). [nd]. Contract AT(30-1)-2726. 8p.

From The International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The use of a PDP-1 (16000 words) for on-line monitoring of bubble chamber measurements is reported. (R.E.U.)

41764 (EIR-66) STABILISERUNG DER VERSTARKUNG VON SCINTILLATIONSSPEKTROMETERN. (Stabilization of Gain of Scintillation Spectrometers). Angelo

Comunetti (Switzerland. Eidgenossisches Institut fur Reaktorforschung, Wurenlingen). June 1964. 42p.

The method provides for a reference γ-source together with a mechanical chopper for generating trains of pulses, which are superimposed on the spectrum under examination. The frequency of the pulses that exceed a fixed discriminator level is periodically compared with the frequency of a standard source, whose pulses also appear as pulse trains superimposed to the spectrum. The resulting feedback signal controls the whole measuring device including the pulse height analyzer. As the stabilizer merely compares quantities of the same kind, it is inherently insensitive to small variations in circuit elements and of ambient conditions. Due to the use of the chopper, the spectrum to be analyzed is kept completely clean from pulses originating from the reference source. A prototype was built; its factor of stabilization is 800 and the characteristic regulating time 3 sec. (auth)

41765 (HW-71710(Rev.)) HANFORD CRITICALITY DOSIMETER. P. E. Bramson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 24, 1962. Revised Feb. 8, 1963. Contract [AT(45-1)-1350]. 21p.

A neutron dosimeter was developed for measuring the neutron dose distribution and spectrum from a nuclear radiation excursion. The neutron spectrum measurement yields five energy groups while the dose measurement will give the single collision theory RBE neutron dose over a wide range of neutron energies with an accuracy of ±15% within the range of a few rads to several thousand rads. Measurement of gamma dose between 10 and 10,000 rads is also provided. Distinct advantages of the Hanford Criticality Dosimeter over other presently available neutron dosimeters are: (1) absence of predose radioactivity in dosimeter components, (2) absence of toxic dosimeter components, and, (3) simple and rapid dose evaluation techniques. Unit cost of the completely-installed dosimeter is less than fifty dollars. (auth)

41766 (IAE-599) ELEKTRONNAYA CHAST USTANOVKI DLYA ISSLEDOVANIYA EFFEKTA MESSBAUERA. (Electronic Part of an Apparatus for Investigating the Mössbauer Effect). K. P. Aleshin, G. P. Mel'nikov, and E. P. Stepanov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 19p.

Descriptions are given of the design and operational principles of an electron device with a constant-velocity vibrator drive for measuring Mössbauer effect. The possibilities of measuring Mössbauer spectra by means of a multichannel recorder were analyzed, and some data are given on a device with linear velocity changes and a multichannel recorder operating with a time selector. The obtained spectra are given, and the efficiencies of single- and multi-channel devices were estimated. (tr-auth)

41767 (IEA-67) A PRECISION CURRENT INTEGRATOR. Raul Brenner (São Paulo, Brazil. Universidade. Instituto de Energia Atômica). Mar. 1964. 21p.

A solid-state digital precision current integrator was developed for measuring current as low as 10^{-7} amp with a precision within ±0.2%. The dynamic range is of 10^{-7} to 2×10^{-3} amp. Associated semiconductors, instruments, an integrator current meter, and a command circuit for nuclear instrumentation are described with complete electronic diagrams. The aim of the system as a whole is the command of counting arrangements, by preseting an amount of charge furnished by the current from the beam of an electrostatic accelerator or an ionization chamber coupled at a nuclear reactor. (auth)

41768 (INSJ-77) DISCRIMINATION OF CHARGED PARTICLES IN NUCLEAR EMULSIONS. Chieko Nagoshi (Tokyo Univ. Inst. for Nuclear Study). July 22, 1964. 46p.

The discrimination of tracks produced by protons, deuterons, tritons, and alpha particles in 100-μ Sakura nuclear emulsions is demonstrated. The identification is accomplished from the relation between the specific energy loss and grain density by selection of the sensitivity of the nuclear plate and the degree of development. (R.E.U.)

41769 (JINR-E-1806) PROGRESS IN DATA HANDLING FOR HIGH-ENERGY PHYSICS. Y. Goldschmidt-Clermont (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 63p. (CONF-550-78)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A review is presented of papers on data handling for systems such as bubble chambers, spark chambers, etc. The use of stored-program digital computers on-line and advances in man-computer relations are considered. Specific research projects are cited and discussed. A bibliography of 69 references is included. (R.E.U.)

41770 (JINR-P-1695) PRIMENENIE FOTOCHUVSTVITELVNOGO POLUPROVODNIKOVOGO SCHETCHIKA DLYA OPREDELENIYA INTENSIVNOSTI I VREMENNOI MAKROSTRUKTURY PUCHKOV CHASTITS VYVEDENNYKH IZ USKORITELYA. (An Application of Photosensitive Semiconductor Counter for Determining the Intensity and Time Microstructure of Particle Beams Extracted From the Accelerator). Yu. K. Akimov, A. I. Kalinin, E. I. Rozanov, and A. I. Sidorov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 7p.

A device is described in which a combination of a plastic scintillator and a semiconductor counter is used as a nuclear radiation detector. (auth)

41771 (JINR-P-1764) IZOTROPNIYA RAZRYADNAYA KAMERA S VODORODYNM I GELIEVYM NAPOLNENIEM. (The Isotropic Discharge Chamber with Hydrogen and Helium Filling). V. I. Komarov and O. V. Savchenko (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 8p.

An isotropic discharge chamber designed to record the tracks of charged particles is described. The chamber has a fiducial volume of $30 \times 30 \times 20$ cm^3, and is filled with helium. A chamber with a fiducial volume of $30 \times 30 \times 6$ cm^3 filled with hydrogen or with a mixture of hydrogen and helium is also described. Some characteristics of the arrangement are given and the photographs of the tracks are shown. (auth)

41772 (KFKI-1491/A) EXPERIMENTAL PROBLEMS IN FAST NEUTRON SPECTROSCOPY. A. Adam, Gabriella Palla, E. Pasztor, and P. Quittner (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1963. 8p.

The efficiency and its dependence on energy was determined experimentally for fast-neutron scintillation detectors. The accuracy of the time-of-flight measurement could be considerably improved with the use of a simple circuit. On a large 50×250 mm plastic phosphor, time resolutions of 1.1 and 1.6 m/μsec were achieved without loss in efficiency for 2-Mev and less than 0.1-Mev threshold proton energies, respectively. The combined application of the pulsed source and associated particle methods considerably reduces the number of random coincidences, and this shortens the measuring time by about an order of magnitude. (auth)

41773 (NYO-3246-1) STUDY OF THE NOISE CHARACTERISTICS AND ENERGY RESOLUTION OF CONTOURED SEMICONDUCTOR RADIATION DETECTORS. Semi-Annual Report. Gerald C. Huth (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). [1964]. Contract AT(30-1)-3246. 52p.

The application of geometrical control of the surface electric field of a p-n junction to devices for use in particle radiation detection was studied in the region of relatively low base resistivity. The effects of various surface angles on the peak surface field and junction characteristics were determined for a number of different base resistivities. The results of surface contouring are shown to be what is thought to be a unique combination of device surface stability with minimum noise and high value of internal electric field. The latter may be useful in providing resistance to radiation damage and, additionally, allows study of possible internal device multiplication effects. However, at peak junction field values of 150 to 175 kv/cm (representing about 90% of the field value necessary to cause avalanche breakdown) multiplication in the form of any general, linear pulse enhancement is not observed with incident electrons. An initial series of photomeasurements, on the other hand, indicate possible photocurrent multiplication at these field values. Extension of the contouring idea to very low angles provides a detector geometry which allows direct exposure of the reverse bias created space charge region over a large area. This geometry, it was thought, with a combination of windowlessness, low capacitance, and stability, would allow detection of very low energy particles. Initial experiments with protons of 100 kev energy and low energy electrons appear encouraging. (auth)

41774 (NYO-3246-2) STUDY OF SURFACE CONTOURING AS APPLIED TO SEMICONDUCTOR RADIATION DETECTORS. Annual Report. Gerald C. Huth (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). 1964. Contract AT(30-1)-3246. 47p.

Work on the application of geometrical surface field control (termed "surface contouring") to semiconductor p-n junctions of use in radiation detection and spectroscopy is reported. Effort was directed during the period toward the study of internal pulse amplification observed when particles are made incident on the junction side of the detector, and the internal peak field is raised to a sufficiently high value (greater than 60 kilovolts/cm). What might be considered significant multiplication begins at 150 to 200 kilovolts/cm. This effect is entirely reproducible and was observed with incident electrons, protons, and alpha particles. The amplification factor of the one junction structure studied is such that 5 Mev alpha interactions can be seen directly on a 50 ohm transmission line (pulses of 2 to 5 v in height) and 50 kev electron pulses seen on an oscilloscope using a simple emitter-follower coupling. A model to describe internal amplification behavior is being formulated. (J.R.D.)

41775 (ORNL-TM-943) DESCRIPTION OF FACILITY RADIATION AND CONTAMINATION SYSTEM INSTALLED IN OAK RIDGE RESEARCH REACTOR BUILDING 3042. J. A. Russell, Jr. (Oak Ridge National Lab., Tenn.). Sept. 15, 1964. Contract [W-7405-eng-26]. 20p.

A Facility Radiation and Contamination System was installed in the Oak Ridge Research Reactor Building 3042 to continuously and automatically monitor the beta-gamma radiation level and air-contamination level in the entire facility and to report this information to a central control panel in the reactor operation control room. Fifteen monitrons and nine air monitors are connected in the instrument network. Operating personnel are first given warning when a "caution level" of 7.5 mR/hr or 1000 counts/min is detected by a monitron or air monitor, respectively, and again when a "high level" of 23 mR/hr or 4000 counts/min is detected. A building evacuation system automatically operates when two or more monitrons or two or more air monitors detect "high level" radiation or air contamination. (auth)

41776 (FTD-TT-64-169) CHEMICAL DOSIMETRY OF HIGH DOSES OF REACTOR RADIATIONS. Olga Gal and Ljubica Josimovic. Translated from Tehnika (Belgrade), No. 6, 1016-21(1963). 17p.

The problem of determining radiation doses absorbed by materials which were exposed in reactors, is discussed. The different mechanisms of absorption of various radiations and the different methods for measuring the dose are reviewed. The operation and advantages of the oxalic acid dosimeter are described in some detail, and results are reported for the dosimetric topography of the 6.5-Mw RA reactor. The use of solid oxalic acid and oxalates for higher doses was also investigated. (D.L.C.)

41777 THE EFFECT OF INVERSE SQUARE LAW ATTENUATION ON THE MEASUREMENT OF GRENZ-RAY EXPOSURE WITH A CAVITY IONISATION CHAMBER. T. E. Burlin (St. John's Hospital for Diseases of the Skin, London). Brit. J. Radiol., 37: 693-5(Sept. 1964).

The effect of the inverse square law attenuation of grenz rays across an ionization chamber on the measurement of exposure is discussed. A correction factor is evaluated for the Victoreen grenz-ray chamber (Model 651), which has a conical air volume. For a conical air volume, there is an optimum shape, for which the correction factor is minimized. (auth)

41778 SCINTILLATION DETECTORS FOR FAST NEUTRONS. Francisco Manero Amoros (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 7: 21-31(Apr.-June 1964). (In Spanish)

In the energy interval from 1 to 20 Mev, the two types of scintillation detectors used are organic detector and Hornyak and Emmerich type detectors. The behavior of these two types was analyzed and the results obtained on cross section measurements are reported. The efficiency of organic scintillators, energy spectra of recoil proton, carbon and hydrogen dispersion, double dispersion of hydrogen, boundary effects, non-linear response, statistical fluctuations, gamma and electron background, and elimination of the background are the behavior aspects of the organic scintillators studied. (J.S.R.)

41779 CAPTURE GAMMAS FOR NEUTRON DOSIMETRY WITH A FILM BADGE. L. T. Caruthers and E. J. Story (Univ. of North Carolina, Raleigh). Health Phys., 10: 667-72(Sept. 1964).

Thermal neutron capture in cadmium foil, that is used to minimize the gamma energy response of photographic film used in personnel film badge dosimeters, will produce capture gamma rays that can be evaluated for thermal neutron dose. Calculations show that cadmium filters should produce a gamma intensity, from the (n,γ) reaction, equivalent to 1.98 roentgens per rem of thermal neutrons captured for 2π geometry. Experimental results utilizing Du Pont type 508 dosimetry film and 30-mil cadmium filters show a response of 1.96 ± 0.09 roentgens per rem of thermal neutrons. Neutron exposures were made in the thermal column of the N. C. State heterogeneous reactor. These results indicated that ordinary film badge dosimetry utilizing the usual cadmium filters can determine the thermal neutron dose to good accuracy even with substantial gamma ray contribution. (auth)

41780 A COUNT-INTEGRATOR FOR DIRECT INDICATION OF RELATIVE ACTIVITIES. R. Oliver and G. T. Warner (Churchill Hospital, Oxford and Nuffield Dept. of Clinical Medicine, Oxford). Intern. J. Appl. Radiation Isotopes, 15: 457-60(Aug. 1964).

This instrument displays on a meter the count above the background for a radioactive sample, the sample and background counts being integrated over equal time intervals. The meter sensitivity can be adjusted so that the activity of a standard is given directly by the meter scale reading, and the activities of other samples are then displayed relative to this standard. The use of the instrument is described to indicate directly percentage of dose in urine samples or thyroid uptake in ^{131}I tests, total ^{58}Co B$_{12}$ excretion in fecal samples, and blood volume. (auth)

41781 ON THE MAGNITUDE OF NUCLEAR PHOTOEMULSION BACKGROUND FORMED BY RADIOACTIVE ADMIXTURES AND COSMIC RAYS. B. M. Yakovlev and A. A. Yatis (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 88-91(1964). (In Russian)

The magnitude of nuclear photoemulsion background was measured using the native 100 to 200 μ thick photoemulsions of NIKFI Ya-2, T-3, T-1, and A-2 types. Particle tracks and stars with 2 to 5 prongs were studied and developed. Data are given on the number of tracks as a function of their length and variations in the number of events as a function of photoemulsion lifetime. (tr-auth)

41782 DISTORTION AND SPURIOUS SCATTERING IN NUCLEAR EMULSIONS. Prem K. Aditya and R. K. Puri (Indian Inst. of Tech., New Delhi). J. Sci. Instr., 41: 529-34(Sept. 1964).

Distortion has been measured with special reference to spurious scattering in nuclear emulsions. A strong correlation has been found between the distortion in the depth direction and that in the projected plane. The source of the former has been traced to the non-planarity of the pellicles, while the latter has been found to consist of two components, one due to non-planarity and the other to processing effects. The distortion in the plane of the tracks is shown to give rise to an additional component in scattering. There is strong correlation between this component and the so-called spurious scattering. The glass-backed emulsions have been shown to have a lower level of spurious scattering, in agreement with recognition of the two types of sources of distortion. (auth)

41783 THE APPEARANCE OF EXTRA LINES ON X-RAY DIFFRACTOMETER TRACES DUE TO THE LARGE WINDOW OF THE SCINTILLATION COUNTER. E. G. Boonstra (Council for Scientific and Industrial Research, Pretoria). J. Sci. Instr., 41: 566(Sept. 1964).

It is shown that extra lines found on x-ray diffractometer traces in the neighborhood of strong lines are a result of the large window of the scintillation counter. The effect has been eliminated. The presence of these extra lines could greatly affect the accuracy and interpretation of precise measurements, such as line-profile determinations. (auth)

41784 IONIZATION DEVICES FOR ENERGY MEASUREMENTS IN GAMMA-RAY BEAM. A. P. Komar, S. P. Kruglov, and I. V. Lopatin (Ioffe Inst. of Physics and Tech., Leningrad). Med. Radiol., 9: No. 7, 46-51(July 1964). (In Russian)

Ionization chambers, a quantimeter, and a standard chamber intended for measuring energy in a gamma beam are described. The chambers were calibrated with the aid of a high sensitivity calorimeter within the energy range of 15 to 90 Mev. Correlations between the chamber response to the peak energy of the spectrum and as the diameter of gamma beam are shown. The method of measurements with the aid of the chambers is described. (auth)

41785 CALORIMETRIC DOSE MEASUREMENTS WITH 35-Mev BETATRON ELECTRON RADIATION. J. Nagl (International Atomic Energy Agency, Vienna), A. Sanielevici, and R. Wideroee. Nature, 203: 632-3(Aug. 8, 1964).

Measurements were made to test the response of a calorimeter in a Lucite phantom (70 mm of material in front, and 30 mm behind the absorber) irradiated with 35 Mev electrons at dose rates of about 250 Rads/min. Comparison between the calorimeter and the radiation monitor of the machine (a flat ionization chamber measuring the total electron flux behind the collimators) in the range up to 1000 Rads showed a linear response of the calorimeter with respect to the dose and that the readings of the monitor were proportional to those of the calorimeter. Simultaneous measurements with an ionization chamber showed that the ionization values were systematically lower than the calorimetric values, with a discrepancy up to 25%. (P.C.H.)

41786 AMPLITUDE ANALYZER WITH PHOTOGRAPHIC RECORDER. G. A. Gumanskii and L. K. Panfilova. Nauchn. Tr., Tashkentsk. Gos. Univ., No. 221, 176-9(1963). (In Russian)

Block and circuit diagrams are presented for an alpha-pulse analyzer applicable to an air-filled ion chamber. It continuously photographs pulses appearing on an oscillograph screen connected by control circuits to the ionization detector. Use of the device for analyzing alpha pulses emitted by natural uranium is described. (M.C.G.)

41787 A NEW PREAMPLIFIER FOR SEMICONDUCTOR DETECTORS. S. Takeda (Kyoto Univ.). Nucl. Instr. Methods, 27: 269-74(July 1964). (In German)

A preamplifier for semiconductor counters is described. The first stage is a cascade circuit of 6R-H2. The instability, which charge sensitive amplifiers potentially have, is suppressed by applying a transitron circuit to the second stage. The noise optimization of the pulse shaping circuit is carried out and the equivalent noise charge is 9.5×10^{-17} Coulomb (rms) for the input capacitance of 19 pF. The rise time is 0.4 μs. (auth)

41788 CORRECTION FOR BACKSCATTERING AND ENERGY RESOLUTION IN BETA SPECTROSCOPY BY SURFACE BARRIER DETECTORS. G. Bertolini, F. Cappellani, R. Fantechi, and G. Restelli (C.C.R. Euratom, Ispra, Italy). Nucl. Instr. Methods, 27: 281-4(July 1964).

In the application of solid-state surface barrier detectors to beta spectroscopy, a method for correction of backscattering and energy resolution is presented. The results were applied to correction of the continuous beta spectra of ^{35}S and ^{60}Co. (auth)

41789 A FAST NEUTRON SCINTILLATION SPECTROMETER FOR THE STUDY OF THE NEUTRON SPECTRUM OF Po–Be SOURCE. B. B. Venkatapathi Raju and S. Jnanananda (Andhra Univ., Waltair, India). Nucl. Instr. Methods, 27: 299-300(July 1964).

A scintillation spectrometer with a plastic scintillator was assembled and the spectrum of fast neutrons from the Po–Be source was studied. The spectrum obtained with this spectrometer is in good agreement with the calculated spectrum and that obtained recently by the emulsion technique. (auth)

41790 LOSSES IN SYSTEMS WITH VARIABLE DEAD TIME. B. Souček (Institut "Rudjer Boskovic," Zagreb). Nucl. Instr. Methods, 27: 306-8(July 1964).

The losses in systems with a variable dead time are different from those that occur for a fixed dead time. Some statistical considerations and formulas useful for the calculations of losses in cases that occur frequently are given. The dependence of losses on the dead time distribution function is shown. Losses in a multichannel pulse height analyser having ferrite or magnetostrictive memories and also having a temporary storage systems were studied. (auth)

41791 EFFECT OF THE PRESENCE OF A SOURCE OF β RAYS ON THE CHARACTERISTICS OF α PARTICLES COUNTING FOR A SPARK COUNTER OF THE WIRE-PLANE TYPE. P. Laborie and J. Maurel (Centre de Physique Nucléaire, Faculté des Sciences, Toulouse). Nucl. Instr. Methods, 27: 309-10(July 1964). (In French)

The experiment of Nakaya and his collaborators on the change of efficiency for α particles caused by an intense β radiation was repeated. It is shown that the only effect of the β source is to modify the permanent current due to the corona discharge. This change is explained by considering that metallic β sources act as 2nd cathodes when placed near counters. (auth)

41792 INTEGRATING MULTIPOINT REMOTE-AREA X-RAY SAFETY MONITOR. H. L. Miller (Princeton Univ., N. J.). Nucl. Instr. Methods, 27: 316-20(July 1964).

A multiple-point, remote-area safety monitor for x rays (or gamma radiation) above 50 kev is described. It was designed for use with sources having duty cycles ranging from steady state (e.g. a radioactive source) to a pulse 100 μsec long repeated every 40 sec (e.g. a pulsed x-ray source). Radiation rates from background and dark current equivalent to 0.06 mR/hr to an instantaneous peak of 8000000 mR/hr are handled with a departure from linearity of at most 25% at the highest rate. Long term fatigue in the photomultipliers may cause loss of sensitivity at average rates above 36 mR/hr. Peak pulse current limitations in the photomultiplier further reduce the acceptable average rate if the radiation burst duration is less than 100 μsec, repeated every 40 sec, at an average intensity of 20 mR/hr. The radiation is detected by a commercial plastic scintillator and photomultiplier. Output of the photomultiplier is integrated directly by an operational amplifier and polystyrene capacitor. Radiation dose for one day is recorded on a strip chart recorder with a three cycle logarithmic scale from 0.1 to 100 mR. (auth)

41793 A METHOD FOR AUTOMATIC COMPENSATION OF DEAD TIME LOSSES. F. Rau and G. H. Wolf (Max-Planck-Institut für Physik und Astrophysik, Munich). Nucl. Instr. Methods, 27: 321-2(July 1964). (In German)

In the measurement of statistical events a method is given for automatic compensation of dead-time losses using feedback in digital and analog techniques. (auth)

41794 LIQUID SCINTILLATION COUNTER FOR NEUTRONS WITH SUPERIOR DISCRIMINATION AGAINST GAMMA RAYS. O. J. Hahn and R. C. Axtmann (Princeton Univ., N. J.). Nucl. Instr. Methods, 27: 323-6(July 1964).

A need for a detector that would respond to neutrons from thermal energies up to the fractional Mev range led to the construction of a fairly large (0.85 liters) liquid scintillator. The scintillation solution contained equal amounts of toluene and methyl borate with the normal abundance of ^{10}B plus PBD and POPOP. A combination of pulse shape discrimination and integral pulse height discrimination gave relatively low efficiencies for thermal neutron detection (≤4%) but permitted the neutron to ^{60}Co gamma efficiency ratio to increase from 10 to 10^4, while the neutron efficiency decreased by a factor of only 3.3. (auth)

41795 A PROTON RECOIL FAST NEUTRON SPECTROMETER WITH SOLID STATE DETECTORS. A. S. Figuera and C. Milone (Università, Catania, Italy). Nucl. Instr. Methods, 27: 339-40(July 1964).

A neutron spectrometer was designed for energies in the range between 10 and 17 Mev, based on a variation of the classic recoil telescope spectrometer made by a thin hydrogenous converter, a gas proportional counter, and a crystal scintillator. The proportional counter was replaced by a transmission solid-state detector and the scintillation counter was replaced by a thick solid-state detector. The neutron energy spectrum is obtained from the energy spectrum of the recoil protons produced in the polyethylene converter. (M.C.G.)

41796 MEASUREMENT OF PARTICLE IONIZATION POWER IN A SPARK CHAMBER. V. A. Lyubimov and F. A. Pavlovsky (Inst. of Theoretical and Experimental Physics, Moscow). Nucl. Instr. Methods, 27: 342-5(July 1964).

An attempt was made to measure the ionization power in a spark chamber with a large gap between the electrodes. The chambers were irradiated in a beam of positive 600-Mev particles. They were filled with Ne + 0.03% propane admixture under the pressure of 540-mm Hg and placed close to each other so that the particles initiating the master pulse passed through both chambers. The tracks from protons and mesons(π^+) were appreciably different. The spark discharges initiated by the particles with higher ionization density had a much higher number of bunches than the discharges from the particles with minimal ionization. The luminosity ratio of the proton and meson(π^+) tracks proved to be 3.0 ± 0.4, which is close to the ratio of the particles ionization power. It was found that at definite conditions the spark discharge itself spreading in the direction of the particle motion contains information about the ionization power of the particle. (M.C.G.)

41797 A NEW SINGLE-CHANNEL PULSE-HEIGHT ANALYZER. Mizuki Mori (Japan Radiation and Medical Electronics, Inc., Tokyo). Nucl. Instr. Methods, 27: 348-50(July 1964).

A single-channel pulse-height analyzer was designed, the window width of which can be set in both upper and lower sides of center energy E in the same amount ΔE, and varies in proportion with E. Therefore, the ratio of the window width to center energy remains constant. Circuit drawings are shown. Gamma spectra of ^{226}Ra and its decay products were measured with this analyzer and a conventional one. The new design allowed the wide range of energy to be scanned without losing spectral detail. (M.C.G.)

41798 He^3–Ne–CH$_4$ MIXTURES IN PROPORTIONAL COUNTERS FOR THERMAL NEUTRONS. V. E. Krohn, Jr. (Argonne National Lab., Ill.). Nucl. Instr. Methods, 27: 351-2(July 1964).

Three counters were constructed to demonstrate that mixtures of ^{3}He–Ne–CH$_4$ give a good performance in counters similar in size to BF$_3$ counters ordinarily used in thermal neutron work (~1 in. diam). The counters contained 2, 30, and 46.7 psi of ^{3}He and exhibited greater efficiency than BF$_3$ counters. (M.C.G.)

41799 RELATION BETWEEN THE CHARACTERISTIC CURVES OF IONIZATION CHAMBERS FILLED WITH LIQUID HEXANE AND THE SPECIFIC IONIZATION OF INCIDENT RADIATION. POSSIBLE APPLICATION AS A MEASUREMENT OF THE QUALITY FACTOR OF COMPLEX RADIATION. D. Blanc, J. Mathieu, and L. Torres (Centre de Physique Nucléaire, Faculté des Sciences, Toulouse). Nucl. Instr. Methods, 27: 353-4(July 1964). (In French)

The ionization current in ionization chambers filled with liquid hexane and exposed to alpha particles, gamma rays, and neutrons was measured as a function of the potential difference between the electrodes at different fluxes and electrode spacings. For a given particle, the plateau of the curves at different fluxes extrapolated to the same characteristic point. The points are in the order of the quality factors of the radiations, permitting determination of the quality factors of unknown or mixed radiations. (D.C.W.)

41800 IMPROVEMENTS IN TECHNIQUES FOR 4π COUNTING. R. Withnell (Brookhaven National Lab., Upton, N. Y.). Nucl. Instr. Methods, 28: 260(Aug. 1964). (BNL-7582)

The use of palladium for the conductive coatings of 4π source carriers is proposed, and advantages over gold are claimed. (auth)

41801 USE OF POLYMETHYL METHACRYLATE PLATES FOR ELECTRON BEAM MEASUREMENTS AT ENERGIES ABOVE 1 Mev. R. W. Dressel (New Mexico State Univ., University Park and Nuclear Effects Lab., White Sands Missile Range, N. Mex.). Nucl. Instr. Methods, 28: 261-6(Aug. 1964).

Flat plates of clear polymethyl methacrylate exposed to an electron beam develop a characteristic coloration the optical density of which can be measured with an ordinary photographic densitometer. Calibration of the optical density against electron exposure was obtained, together with information about fading exposure. The energy dependence of the calibration was also measured. A few examples of the application of this technique to electron beam measurements are given. (auth)

41802 AN IMPROVED SCINTILLATION BETA SPECTROMETER. J. F. McClary and J. A. Eisele (Texas Agricultural and Mechanical Coll., College Station). Nucl. Instr. Methods, 28: 267-8(Aug. 1964).

A scintillation beta spectrometer using NaI(Tl) as detector was constructed and tested. The spectrometer has a resolution of 8.3% on the 624-kev conversion electron peak of ^{137}Ce. (auth)

41803 A CHERENKOV CHAMBER USING LARGE CHERENKOV ANGLES. R. Benwell (Univ. of Southhampton, Eng.). Nucl. Instr. Methods, 28: 269-73(Aug. 1964).

A Cherenkov chamber is described which uses a liquid radiator enclosed in a square-section tube, the walls of which consist of four plane front-surface mirrors. A long radiating path with a small focusing lens aperture can be used while still preserving, in the focused pattern, information about the angle of entry of the radiation particle. An experimental chamber which was used to observe cosmic mesons (μ) is described, and the analysis of the pattern is discussed. An average number of points in each pattern of about 6 was obtained. (auth)

41804 A TARGET CHAMBER FOR PRECISION ANGULAR DISTRIBUTION MEASUREMENTS. E. J. Feldl, P. B. Weiss, and R. H. Davis (Florida State Univ., Tallahassee). Nucl. Instr. Methods, 28: 309-14(Aug. 1964).

A 34.7-cm diameter target chamber was developed for multiple solid-state counter detection of nuclear reaction products. Two rotation tables carry the counters at adjustable radii. The tables are externally rotated and the angular position is read on a scale calibrated to 0.1°. The inherent mechanical precision is 0.01°. (auth)

41805 COMPUTATION OF BETA-RAY LINE SHAPE AND LUMINOSITY IN SPHEROIDAL FIELD AND OTHER MAGNETIC LENS SPECTROMETERS. H. O. W. Richardson (Bedford Coll., London). Nucl. Instr. Methods, 28: 333-40(Aug. 1964).

The use of convolution integrals in the computation of beta line shapes is discussed. Line shapes are found by numerical integration for the case of a lens spectrometer in which the only aberrations present are those due to aperture and to size of source. From the computed shapes, a relation is found between the half width and the relative size of the two aberrations. The relation is used to estimate the dependence of luminosity on resolution in the case of a prolate spheroidal field spectrometer and of a spectrometer which uses a superposition of this field on a uniform field. The performance is compared with that of a uniform-field lens spectrometer of similar size. (auth)

41806 PERFORMANCES OF A P-i-N TYPE SEMICONDUCTOR DETECTOR AT LOW TEMPERATURES. G. Gregoire, J. Heughebaert, G. Lemaitres, J. Oostens, and L. Van Gerven (Institut Interuniversitaire des Sciences Nucleaires, Brussels). Nucl. Instr. Methods, 28: 346-8 (Aug. 1964).

In order to evaluate the information that could be obtained by introducing semiconductor detectors inside bubble chambers, the performance of a P-i-N type detector was investigated at low temperatures. The signal amplitudes given by conversion electrons of ^{207}Bi were determined as a function of temperature for two bias voltages. The best resolution was obtained around 105°K. Below 40°K, no useful signal could be detected. However, cooling the detector during a few hours at temperatures below 40°K did not cause any observable permanent damage. (auth)

41807 A METHOD OF POLYMERIZING AND FABRICATING LARGE PLASTIC SCINTILLATORS. J. A. Eisele and J. F. McClary (Texas Agricultural and Mechanical Coll., College Station). Nucl. Instr. Methods, 28: 355-6 (Aug. 1964).

A method is described by which large pieces of scintillating plastic for use as anti-Compton shields may be produced at a small fraction of the cost for a similar commercial system. The method is safer and requires less machining than standard methods. (auth)

41808 SEMICONDUCTOR DETECTORS. G. Amsel (Laboratoire de l'Accélérateur Linéaire, Orsay, France) and A. Coche. Onde Elec., 44: 443-52(May 1964). (In French)

The general features of semiconductor detectors—detector thickness and signal amplitude, statistical properties of the signal, detection of penetrating particles and gamma rays, particle identification, and associated electronics—are reviewed, and the contribution of French university laboratories to the development of semiconductor detectors is indicated. (J.S.R.)

41809 DOUBLE BARRIER GOLD–SILICON DETECTORS FOR NUCLEAR RADIATION. P. Siffert, L. Stab, and A. Coche (Centre de Recherches Nucléaires, Strasbourg). Onde Elec., 44: 453-5(May 1964). (In French)

The Trousil technique to double the barrier thickness, in which two surface barriers are fabricated on opposite faces of a Si monocrystal with an ohmic contact and a connection between the two electrodes, was used to fabricate double-barrier Au-Si detectors. The electrode configuration giving the maximum sensitive volume was determined. Resolutions of the order of 12 to 15 kev where obtained, as indicated by the ^{137}Cs conversion electron spectrum. A comparison of the single- and double-barrier detectors showed that the double barrier yields a higher number of pulses. The response to electrons is linear. (J.S.R.)

41810 THE SPECTROMETRY OF PROTONS, DEUTERONS, ^{3}He AND α BY SURFACE-BARRIER JUNCTION DETECTORS. M. Sandon, J. P. Longequeue, N. Longequeue, and H. Beaumevieille (Université, Grenoble, France). Onde Elec., 44: 456-7(May 1964). (In French)

Surface-barrier junction detectors were fabricated to study (p,α), (d,α), (d,d), and (d,p) reactions. The resolution of the detectors associated with an ORTEC preamplifier-amplifier was 0.5% with Po 5.3-Mev alpha particles. The fabrication technique used, which is described, permitted the detection of 130-kev deuterons, 12-Mev alpha particles, and 5-Mev protons. Typical spectra were presented. (J.S.R.)

41811 GASEOUS SCINTILLATORS. J.-L. Teyssier and D. Blanc (Faculte des Sciences, Toulouse). Onde Elec., 44: 458-65(May 1964). (In French)

A survey is made of the most important studies on the properties and characteristics of gaseous scintillators. The topics discussed are operational principles, gas filters, wave-length converters, reflectors and geometry effects, detector performance, effect of electric fields on the scintillation, scintillation mechanism, and detection of neutrons and fission products. 109 references. (J.S.R.)

41812 DETECTION OF γ RAYS IN A STRONG FAST NEUTRON FIELD. L. Avan, P. Keller, and G. Roche (Faculte des Sciences, Clermont, France). Onde Elec., 44: 466-72(May 1964). (In French)

The Cherenkov detector is based on the creation of photons in the gold targets and the Cherenkov effect in the plexiglass radiator. The Cherenkov effect is reviewed, and the conditions for the emission of Cherenkov radiation in the plexiglass are given. The factors determining the number of targets are discussed, and the electronic circuits associated with the detector are described. Experiments with electrons at 1.7 Mev on the performance of Cherenkov detectors are reported. The effects of the x-ray beam width, target thickness, and the resolution time of the detectors were determined. (J.S.R.)

41813 THE VARIOUS MODES OF OPERATION OF SPARK COUNTERS IN AIR. J. Maurel (Faculte des Sciences, Toulouse). Onde Elec., 44: 473-5(May 1964). (In French)

A systematic study of the operation of spark counters was made. The ensemble was in air at atmospheric pressure, and the pressure of the water vapor was maintained at 9 torr. By varying the distance between a wire anode parallel to a plane cathode, four modes of operation were identified in the detector. A possible mechanism for the spark was proposed. (J.S.R.)

41814 STUDY OF THE FLUCTUATIONS IN THE 56 AVP PHOTOMULTIPLIER. G. Pfeffer, D. Jeanselme, H. Lami, and A. Coche (Centre de Recherches Nucleaires, Strasbourg). Onde Elec., 44: 476-8(May 1964). (In French)

Fluctuations of the electron transit time and gain in a 56 AVP photomultiplier in pulsed operation were studied, together with the variation of the resolution with the voltage applied to the tube. The effect of illuminating different parts of the photocathode was also determined. (D.C.W.)

41815 BASIS AND DESIGN FOR THE ELECTRONIC INSTALLATION IN A 4π β COUNTER OPERATING IN PROPORTIONAL MODE AT HIGH LEVEL OF COUNTING. Nguyen-Long-Den and L. Bloquet (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). Onde Elec., 44: 479-82(May 1964). (In French)

The difficulties of operating a β counter in the proportional regime were indicated. The solution adopted for overcoming these difficulties was the use of a nonlinear amplifier capable of sustaining high pulses but having a reduced dead time. In this case, no correction for counting loss was necessary if the counting rate was not too high. A nonlinear electronic device which amplifies the small pulses and attenuates the large pulses was developed. The characteristics and circuits of the preamplifier and amplifier stages were determined. (J.S.R.)

41816 A MODERATE-SPEED DEVICE FOR THE DETECTION OF HEAVY PARTICLES. ITS APPLICATION TO THE MEASUREMENTS OF DIFFERENTIAL CROSS SECTIONS. S. Gorodetsky, J. P. Weymann, R. Armbruster, A. M. Bergdolt, M. Bres, A. Chevallier, B. Rabin, and J. C. Sens (Centre de Recherches Nucleaires, Strasbourg). Onde Elec., 44: 483-92(May 1964). (In French)

An electronic system adaptable to both counting and spectrometry using semiconductor detectors was developed. The power resolution of the device is about 300 nsec. The levels and sources of background noise were studied. The amplifiers selected are described. The system was used to measure effective differential reaction cross sections. (D.C.W.)

41817 THE RECENT DEVELOPMENT OF HIGH-SPEED NUCLEAR ELECTRONICS. G. I. Alon (Laboratoire de l'Accelerateur Lineaire, Orsay, France), R. Armbruster, and J. J. Samueli. Onde Elec., 44: 495-9(May 1964). (In French)

The principal techniques used for time and amplitude measurements in French university laboratories are indicated. Coincidence circuits, time analyzers, linear amplifiers, multichannel analyzers in the nanosecond range, and amplitude discriminators are briefly discussed. (J.S.R.)

41818 CIRCUITS FOR HIGH-SPEED EVENTS USING TUNNEL DIODES. G. I. Alon and R. Rausch (Laboratoire de l'Accelerateur Lineaire, Orsay, France). Onde Elec., 44: 500-3(May 1964). (In French)

The performance of a coincidence-anticoincidence selector with a very short dead time is summarized. It is composed of three discriminator-former circuits incorporating a very fast lock gate followed by a coincidence discriminator. The principle of the discriminator-former is discussed, and coincidence circuit and the coincidence-anticoincidence selector are described. (J.S.R.)

41819 TIME-AMPLITUDE CONVERTER. A. Richard (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). Onde Elec., 44: 504-6(May 1964). (In French)

The principles, operation, and characteristics of a time-amplitude converter using a transistorized start-and-stop input trigger are reported. (J.S.R.)

41820 DOUBLE-THRESHOLD DISCRIMINATOR. J. Zen, A. Muser, J. Ruscher, and R. Armbruster (Institut de Recherches Nucleaires, Strasbourg). Onde Elec., 44: 507-12(May 1964). (In French)

The time dispersions introduced in classical discriminators as a function of amplitude, particularly systematic dispersion and statistical fluctuation in scintillator detectors, are examined. The principles of a double-threshold discriminator adapted for slow scintillators are presented, and the circuit is described. The performance of the circuit is reported. (J.S.R.)

41821 180 MCS HIGH-SPEED BINARY SCALER. J. Pigneret, J. J. Samueli, and A. Sarazin (Institut de Physique Nucleaire, Lyon). Onde Elec., 44: 513-15(May 1964). (In French)

A 180-Mcps, high-resolution binary scaler using tunnel diodes is described, together with its performance. The unit is adaptable to all signal forms. (D.C.W.)

41822 HIGH-SPEED DISCRIMINATOR CIRCUIT USING A PLASTIC SCINTILLATOR. F. Cambou, J. C. Guyader, and J. J. Petrelis (Faculte des Sciences, Toulouse). Onde Elec., 44: 544-6(May 1964). (In French)

A fast discriminator circuit using an NE 150 plastic scintillator is described, and the pulse form at different points is indicated. The circuit can be used to analyze alpha or proton spectra in the presence of intense gamma radiation. It was tested with ^{239}Pu alpha particles and ^{22}Na gamma rays. The results obtained with and without the discriminator are presented. (J.S.R.)

41823 THE IDENTIFICATION OF THE NATURE OF NUCLEAR RADIATION BY REFERENCE TO THE FORM OF THE PULSES DELIVERED BY A CsI(Tl) SCINTILLATOR. E. Festa and B. Rosenbaum (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). Onde Elec. 44: 547-50(May 1964). (In French)

A method by which scintillation counter pulses produced by a given category of particles can be selected for analysis is described. The phenomena occurring in the scintillator and photomultiplier are illustrated, and the conversion principle is explained. (J.S.R.)

41824 PARTICLE DISCRIMINATION USING ORGANIC SCINTILLATORS. G. Walter, A. Huck, J. P. Gonidec, and A. Coche (Centre de Recherches Nucleaires, Strasbourg). Onde Elec., 44: 551-3(May 1964). (In French)

In most organic scintillators, a fast and exponential decay of the luminescence is followed by a component of lower intensity, lasting for several microseconds. An apparatus used to study the intensities of the fast and slow components of the monocrystalline stilbene is described. The results obtained for stilbene show that the relation between the particle energy and the slow component is almost linear whereas it is not for the fast component. There is a relative increase of the slow component with specific energy loss. The intensity of both components increases with decreasing temperature. The discrimination characteristics of stilbene for electrons and alpha particles are compared with anthracene, terphenyl, and two liquid scintillators in the presence and absence of the oxygen usually dissolved in the solutions. The results indicate that stilbene can be used to discriminate between alpha particles and protons at energies higher than 1 Mev. (J.S.R.)

41825 THE USE OF AN IBM-650 MACHINE FOR THE AUTOMATIC INTERPRETATION OF SPARK CHAMBER RESULTS. P. Scharff, C. Victor, and R. Willitts (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). Onde Elec., 44: 554-5(May 1964). (In French)

A system for automatic scanning of spark chamber photographs is described, using a flying-spot digitizer and an IBM 650 computer. The scanning time will be about 5 sec/event with a precision approaching 2 in 1000. (D.C.W.)

41826 THE DISTURBANCES INTRODUCED INTO A TRAIN OF PULSES BY THE ELECTRONICS ASSOCIATED WITH A DETECTOR. A. Picot (Laboratoire de Physique Theorique et Nucleaire, Nancy). Onde Elec., 44: 556-9 (May 1964). (In French)

In the case of fast exponential decays, the experimental curve representing the population as a function of time should be handled mathematically in order to restore the original spectrum. The disturbances introduced by the use of a time-amplitude converter associated with a multichannel selector in a study of "α Rossi"-type decay in a reactor are analyzed to determine the time correlations. The results are used to evaluate the error in the determination of the reactor state by the deviation of the critical mass as a function of the counting rate. (J.S.R.)

41827 NUCLEAR ELECTRONICS AT THE INSTITUT DU RADIUM. J.-C. Brun, M. Langevin, J. Teillac, and C. Victor. Onde Elec., 44: 560-4(May 1964). (In French)

The development of nuclear electronics at the Institute of Radium is outlined. Some devices presently used to obtain time, amplitude, and intensity data are discussed, and their characteristics are given. Multiparameter analyzers are also considered. (D.C.W.)

41828 NUCLEAR INSTRUMENTATION AT THE LABORATOIRE DE PHYSIQUE ATOMIQUE DU COLLEGE DE FRANCE. R. Moch (College de France, Paris). Onde Elec., 44: 565-88(May 1964). (In French)

Some recent developments in nuclear instrumentation are briefly described, including particle detectors, classical electronics, fast electronics, and data processing equipment. (D.C.W.)

41829 RESEARCH IN HIGH SPEED ELECTRONICS AND A BRIEF DESCRIPTION OF A COMPLETE ASSEMBLY FOR THE STUDY OF NUCLEAR DATA ADAPTED TO THE 6-Mev VAN DE GRAAFF AT STRASBOURG. S. Gorodetzky and R. Armbruster (Centre de Recherches Nucleaires, Strasbourg). Onde Elec., 44: 589-90(May 1964). (In French)

The requirements on the electronic circuits of systems for detecting particles or radiations of low intensity in intense radiation fields are summarized, and research on such circuitry is outlined. The detection, recording, and analysis systems at the Van de Graaff accelerator are indicated. (D.C.W.)

41830 TIME OF FLIGHT SPECTROMETER FOR FAST NEUTRONS. R. Bouchez, J. Duclos, P. Perrin, I. Szabo, R. Van Zurk, Nguygen Van Sen (Universite, Grenoble, France and Centre d'Etudes Nucleaires, Grenoble, France). Onde Elec., 44: 591-4(May 1964). (In French)

A time-of-flight spectrometer for 14-Mev neutrons was constructed for the study of fast neutron scattering by light nuclei. The total time resolution varies with the experimental conditions. The principle of the spectrometer is outlined with emphasis on the time-amplitude converter and reduction of secondary effects. Results obtained on the scattering of neutrons by ^{12}C are reported. (J.S.R.)

41831 THE SPECTROMETRY OF FAST NEUTRONS BY MEASUREMENT OF TIME OF FLIGHT. J. Roturier and G. Y. Petit (Faculte des Sciences, Bordeaux). Onde Elec., 44: 595-7(May 1964). (In French)

A time-of-flight spectrometer developed for measuring the scattering of fast neutrons is briefly described, with emphasis on the time-amplitude converter. Experimental results on neutron inelastic scattering by carbon and silicon and on the effect of the neutron flux on the time resolution are included. (D.C.W.)

41832 TIME-OF-FLIGHT FAST NEUTRON SPECTROMETER WITH A SWITCHING APPARATUS FOR 4π DETECTORS AND WITH NEUTRON-GAMMA DISCRIMINA-

TION. Y. Flamant and R. Ballini. Onde Elec., 44: 598-601(May 1964). (In French)

The parasitic pulses caused by gamma radiation in the time-of-flight fast neutron spectrometer were eliminated by a form discriminator, the principle of which is discussed. The assembly of the neutron-gamma discriminator and the determination of the efficiency of the detection circuits are described. The procedure used in the switching device is also considered. (J.S.R.)

41833 A TELESCOPE FOR HEAVY CHARGED PARTICLES. J. L. Irigaray and G. Y. Petit (Faculte des Sciences, Bordeaux). Onde Elec., 44: 602-4(May 1964). (In French)

A telescope was constructed with which the nature of the particles emitted in nuclear reactions can be determined and their energy can be measured. The energy loss is measured in one of two plastic scintillators, from which the specific ionization is deduced. The residual energy is measured with a CsI(Tl) scintillator. From the energy and specific ionization, the nature of the charged particles is determined. The mechanical and electronic assembly of the telescope is described. The results obtained on the time resolution of the triple coincidence circuit and the energy resolution for alpha particles and protons indicate that the instrument can be used for the study of (n, charged particle), (n,p), and (n,α) reactions. (J.S.R.)

41834 MEDIUM-SPEED ELECTRONIC CIRCUITS USED FOR THE STUDY OF RECOIL NUCLEI. G. Corbe, J. Deschamps, and A. Richard (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay). Onde Elec., 44: 605-9(May 1964). (In French)

The adaptation of an experimental device set up for the study of recoil nuclei to the detection and study of low-energy pulses produced by parasitic reactions is discussed. The preamplifier, amplifier, discriminator gate, adapter, and coincidence circuits are described. (J.S.R.)

41835 PHOTO-MECHANICAL RECORDER FOR COSMIC-RAY METER. C. Ishii (Meteorological Research Inst., Tokyo). Papers Meteorol. and Geophys. (Tokyo), 14: 225-6(Dec. 1963).

A system for continuous recording of cosmic-ray observations is described, using a Hofmann electrometer and a mechanical scanning arm with a phototransistor. (D.C.W.)

41836 SPECTROMETRIC LOW-NOISE PULSE AMPLIFIERS. (A REVIEW). V. G. Brovchenko and Yu. D. Molchanov (Inst. of Nuclear Energy, USSR). Pribory i Tekhn. Eksperim., No. 4, 5-19(July-Aug. 1964). (In Russian)

The fabrication of low-noise amplifiers for nuclear radiation detectors is surveyed. Basic consideration is given to charge amplifiers for semiconductor detectors. Electron-tube and transistorized amplifiers and preamplifiers are discussed. (M.J.T.)

41837 CHERENKOV TOTAL ABSORPTION GAMMA SPECTROMETER. A. V. Kutsenko, V. N. Maikov, and V. V. Pavlovskaya (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 38-43(July-Aug. 1964). (In Russian)

A Cherenkov total-absorption γ spectrometer with conical radiator of TF-1 lead glass and with a single FEU-49 is described. An energy resolution of 43 to 19% is obtained in the operating region of 80 to 600 Mev. Calibration was carried out on the FIAN synchrotron with maximum energy of 680 Mev. (tr-auth)

41838 INSTALLATION FOR MÖSSBAUER EFFECT INVESTIGATIONS. K. P. Aleshin, I. I. Lukashevich, B. N. Samoilov, V. V. Sklyarevskii, E. P. Stepanov, and N. I. Filipov. Pribory i Tekhn. Eksperim., No. 4, 43-9(July-Aug. 1964). (In Russian)

An apparatus is described for the study of the Mössbauer effect, in which the movement is provided by a special electrodynamic vibrator. The triangular-form voltage for feed to the set coil of the vibrator from the generator produces constant-velocity movement. Various values of the velocity for 0 to 8 cm/sec for bias amplitude of 1 to 2 mm are obtained by changing the generator voltage. The apparatus design allows measurements to be made by scattering as well as absorption. The characteristics of the apparatus were investigated using the ^{57}Fe spectrum in Fe_2O_3. (tr-auth)

41839 ON IMPROVING THE ACCURACY OF NEUTRON TIME-OF-FLIGHT MEASUREMENTS. A. Adam, G. Palla, and P. Kvitner (Central-Scientific-Research Inst., Academy of Sciences, Hungary). Pribory i Tekhn. Eksperim., No. 4, 49-53(July-Aug. 1964). (In Russian)

A time-to-pulse height converter intended for measurements of fast-neutron energy is described. Time straggling, connected with the continuous amplitude spectrum of monoenergetic neutrons, strongly affects the resolution. This straggling was significantly decreased by the corresponding summation of pulses from the converter and the neutron detector. The resolution of a plastic scintillation detector of dimensions 50 × 250 mm^2 was improved from 3 to 1 nsec, while the efficiency for 14.7-Mev neutrons remained unchanged. (tr-auth)

41840 MAGNETIC TRACK SPECTROMETER WITH SPARK CHAMBERS. I. A. Radkevich, V. V. Vladimirskii, V. V. Sokolovskii, and A. M. Blagorodov. Pribory i Tekhn. Eksperim., No. 4, 54-5(July-Aug. 1964). (In Russian)

A description is given of a track spectrometer with an upper yoke magnet with straight narrow slits through which a group of spark chambers within the magnet is photographed. The spark discharges in each group of chambers are photographed by three devices using mirrors placed so that the optical paths from all the chambers are equal. (tr-auth)

41841 HYDROGASDYNAMIC CALCULATION OF THE MECHANISM OF PRESSURE CHANGES IN A LARGE BUBBLE CHAMBER. Yu. A. Budagov, V. P. Dzhelepov, V. G. Ivanov, Yu. F. Lomakin, V. B. Flyogin, and P. V. Shlyapnikov (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 56-65(July-Aug. 1964). (In Russian)

A hydrogasdynamic method is presented for calculating the basic parameters in bubble-chamber construction and the mechanism of pressure change. The mathematical description of the processes of pressure change within the chamber and in the pneumatic system is rather general, since the method is used for the calculation of various construction schemes of practical interest. (tr-auth)

41842 COMPUTATION OF THE CONIC RE-PROJECTION OF CHAMBER STEREOPHOTOS DURING THE DETERMINATION OF MOMENTA OF CHARGED PARTICLES MOVING IN MAGNETIC FIELD. D. B. Pontekorvo (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 66-70(July-Aug. 1964). (In Russian)

The conic reprojection of chamber stereophotographs for the determination of the momenta of charged particles moving in a magnetic field is analyzed. The case is considered where the photographing of the chamber and the reprojection of the stereocompressions are produced by identical objectives, whose optical axes are parallel to the magnetic field. Relations are obtained which allow the calculation of the radius of curvature of the orthogonal projection by the magnitude of the measured radius of curvature of the particle-track projection. (tr-auth)

41843 MEASUREMENTS OF THE MASS OF CHARGED PARTICLES WITH A SMALL RESIDUAL RANGE IN NUCLEAR PHOTOEMULSION. A. O. Vaisinberg, E. D. Kolganova, and N. V. Rabin. Pribory i Tekhn. Eksperim., No. 4, 71-5(July-Aug. 1964). (In Russian)

Properties and some ionization parameters of nuclear photoemulsions of various types were investigated to find the optimal conditions for the measurement of the masses of charged particles with small residual range. It appears that the normal emulsion NIKFI-K, developed by the isothermal method, best answers this problem. The ionization parameter is found for the emulsion K, providing the possibility of measuring the magnitude of mass for residual range ~200 μ. (tr-auth)

41844 OPERATION OF A DEVICE FOR AUTOMATIC RECORDING OF IONIZATION AND MOMENTUM ON THE PATHS OF RELATIVISTIC PARTICLES. A. E. Voronkov, M. F. Soloveva, L. V. Sukhov, M. I. Tret'yakova, and M. M. Chernyavskii (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 75-7(July-Aug. 1964). (In Russian)

The relative ionization (the ratio of blob density on a track to that on primary proton beam tracks) and momentum (from multiple-scattering measurements) were measured on tracks of secondary relativistic particles from stars. The variation of ionization with depth of the event is given for both hand and machine measurements. Relative ionization measurements are compared for hand and machine methods. Some performances characteristics of the machine are tabulated. The machine method represents a reduction in measuring time to $\frac{1}{10}$ of that with manual measurements; the accuracy of the machine method requires only one measurement per track. (M.J.T.)

41845 RECORDING OF NUCLEAR FISSION BY MEANS OF AMORPHOUS MEDIA WITH SiO_2. V. P. Perelygin, S. P. Tret'yakova, and I. Zvara (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 78-80(July-Aug. 1964). (In Russian)

A method of registering fragments from fission of nuclei in amorphous media containing SiO_2 is described. The method is based on etching the surfaces of the irradiated media by hydrochloric acid solutions. (tr-auth)

41846 IONIZATION CHAMBER AND COUNTER FOR RECORDING HLα EMISSION LINES. A. B. Dmitriev, V. V. Katyushina, and L. S. Sorokin (Inst. of Applied Geophysics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 81-4(July-Aug. 1964). (In Russian)

A description is given of the KFL-2 ionization chamber and SEM-1 Geiger-Mueller counter intended for the recording of the radiation of the L_α line of H. Diagrams are presented of the spectral sensitivity of the KFL-2, the variation of the G-M counting speed on radiation intensity. (M.J.T.)

41847 METHOD OF OBTAINING SILICON SPECTROMETRIC DETECTORS WITH WIDE RANGE OF SENSITIVE LAYER. Chen-wa Wang, A. I. Sidorov, L. P. Sidorova, and L. I. Simonova (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 84-6(July-Aug. 1964). (In Russian)

A method for obtaining silicon spectrometric detectors with a wide range of volume charge is described. The method is based on a new phenomenon occurring during electric drift of lithium ions in silicon. An explanation of this phenomenon is proposed. (tr-auth)

41848 A GASEOUS THRESHOLD CHERENKOV COUNTER OPERATING WITH A WIDE RANGE OF ANGLES. G. L. Bayatyan, O. Ya. Zel'dovich, and L. G. Landsberg. Pribory i Tekhn. Eksperim., No. 4, 87-9 (July-Aug. 1964). (In Russian)

The construction of a gas threshold Cherenkov counter operating in a wide range of angles (~20°) is described and results of tests are presented. Diagrams of the counter and the testing apparatus are given. The counter efficiency was determined as a function of gas pressure, angle of particle passage through the counter, and pion momentum. (M.J.T.)

41849 LIGHT RECOIL OF ORGANIC SCINTILLATORS AS A FUNCTION OF PROTON ENERGY. D. V. Viktorov, S. F. Kilin, and I. M. Rozman (Inst. of Physics and Tech., Academy of Sciences, Georgian SSR). Pribory i Tekhn. Eksperim., No. 4, 90-3(July-Aug. 1964). (In Russian)

The experimental method is described, and results are presented for an investigation of the dependence of emission on proton energy in the range 1.7 to 14.1 Mev for solid plastic scintillators based on polystyrene and polyvinyltoluene, stilbene, tolan, and naphthalene with luminescent impurities and for liquid scintillators based on toluene and cyclohexane. The experimental data are compared with theory; parameters characterizing the degree of deviation of the emission-particle energy dependence from linear are determined. (tr-auth)

41850 EFFICIENCY OF FAST NEUTRON SCINTILLATION DETECTORS. A. Adam, G. Palla, and P. Kvitner. Pribory i Tekhn. Eksperim., No. 4, 93-6(July-Aug. 1964). (In Russian)

The magnitude and energy dependence of the efficiency of a fast neutron scintillation detector were determined experimentally. The energy dependence obtained experimentally agrees well with calculations. Neutrons of various energies were obtained by scattering on hydrogen the neutrons of the reaction $T(d,n)^4He$. The emission was determined by recording the associated α particles. (tr-auth)

41851 SCINTILLATION DETECTOR FOR COSMIC RADIATION. V. Kr. Zlatarov. Pribory i Tekhn. Eksperim., No. 4, 97-8(July-Aug. 1964). (In Russian)

A method for the approximate calculation of cosmic-ray momentum spectra is proposed. Expressions for the pathlength spectrum of the hard component are derived, assuming the pathlength depends on the energy loss in the scintillator. The differential range spectrum was calculated for a cylindrical scintillator and is compared with the corresponding intergral spectrum, obtained from graphical integration. The integral range spectrum considering variation of ionization losses in the scintillator and momentum amplitude scattering from nonhomogeneous collection of light in different scintillator areas is presented. Comparison is also made with previously obtained experimental points, and differences between experimental and calculated values are discussed. (M.J.T.)

41852 A DESIGN FOR RECORDING VARIOUS-ENERGY γ QUANTA IN PRESENCE OF INTENSE CHARGED PARTICLE FLUX. A. A. Sanin, Yu. V. Mineev, and B. M. Yakovlev (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 4, 119-21(July-Aug. 1964). (In Russian)

A device made up of tunnel diodes and semiconducting triodes, intended for recording γ quanta of various energies in the presence of intense charged-particle currents, is described. The operating principle of the device is based on the separation of signals from a scintillation counter with a two-layer scintillator. Tunnel-diode threshold devices are used for discrimination. (tr-auth)

41853 MULTICHANNEL DEVICE FOR RECORDING PULSES FROM SEVERAL NUCLEAR RADIATION DETECTORS. Yu. A. Blyumkina, L. A. Kamaeva, and N. I. Rodionov. Pribory i Tekhn. Eksperim., No. 4, 122-5(July-Aug. 1964). (In Russian)

A device intended for simultaneous recording of pulses from several radiation detectors is described. The apparatus for coding pulses from each transducer using a delay line enabled the circuitry to be limited to a single amplifying and discrimination circuit for all transducers. Pulse decoding is also carried out by delay lines. The dead time of the apparatus for net input in microseconds is equal to the number of transducers plus one. (tr-auth)

41854 A PLASTIC WELL SCINTILLATION DETECTOR FOR ASSAYING LARGE VOLUME SAMPLES CONTAINING GAMMA EMITTER. Hirotake Kakehi, Noboru Arimizu, Kenji Saegusa, Hatsumi Nagasawa, and Kodo Akiba (Chiba Univ., Japan). Radioisotopes (Tokyo), 13: 275-81(July 1964). (In Japanese)

Measurements of low γ activities accumulated in a large volume sample, for example, excrement of a patient or a laboratory animal, are simplified by using a large volume well counter. A large plastic scintillator, provided with a large volume well sized 10 cm deep by 15 cm diameter, which makes it suitable to assay large volume samples containing γ emitter, because of a comparatively low cost and high sensitivities was developed. The detector assembly is housed in the lead shielding, at least 7.5 cm on any direction, insuring effective depression of background. A 5 in. diameter photomultiplier tube is attached to the scintillator without a light pipe. High voltages of the photomultiplier tube ranging from 1,050 to 1,250 volt yield the maximum ratio of sample counting to background. The plastic scintillator shows no plateau region on a plateau curve and then the high voltage yielding the maximum ratio of sample counting to background is most suitable to assay the sample. The plastic scintillator is not capable of good pulse height resolution against γ rays as it does not exhibit a photoelectric peak. This fact makes it appropriate where only one radioisotope is involved in a sample. The detector used can be cooled by dry ice packed in a small refrigerating chamber surrounding the photomultiplier tube. Cooling the tube results in a remarkable depression of noise levels, showing 30% reduction of background at −5°C compared with that of room temperature at 25°C. Counting geometry for samples, ranging in size from point sources to 1,000 ml containers, is examined by using various radioisotopes containing identical activities in the well of the detector. Either movement of the sample on a vertical direction or increase of a sample volume is followed by a wide variety of counting efficiency ranging from 100 to 60%. However, movement on horizontal plane is not critical. By using a lead plate, 4 mm thick, covering the bottom of the well, the variety of efficiency can be minimized. (auth)

41855 NANOSECOND PULSE AMPLIFIERS. James S. Lunsford (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 35: 1483-5(Nov. 1964). (LADC-6459)

A group of fast amplifiers was developed primarily for use with fast semiconductor detectors in time-of-flight experiments. They have risetimes of approximately 1 nsec, gains of 100, and dynamic ranges of 50 : 1. (auth)

41856 RADIO-FREQUENCY OSCILLATOR FOR HETERONUCLEAR MAGNETIC DOUBLE RESONANCE. Robert C. Hopkins (Harvard Univ., Cambridge, Mass.). Rev. Sci. Instr., 35: 1495-7(Nov. 1964).

An amplitude-modulated crystal oscillator to be used in conjunction with a Varian HR60 NMR spectrometer system was developed for heteronuclear magnetic double resonance. It can be operated at frequencies from 3 to 50 Mc with a stability of about 1 part in 10^8 over a 5-min interval. The oscillator will transmit a useful r-f magnetic field of at least 0.1 G to the NMR probe. (auth)

41857 HIGH RESOLUTION GAS ČERENKOV COUNTER—DISC. P. Duteil, L. Gilly, R. Meunier, J. P. Stroot, and M. Spighel (CERN, Geneva). Rev. Sci. Instr., 35: 1523-4(Nov. 1964).

The limit set by chromatic dispersion on the velocity resolution of Cherenkov counters can be reduced by more than an order of magnitude by optical correction of chromatism. Performance of a counter built according to this principle is presented, showing ability to separate particles differeing in velocity by only a few parts in 10^6. (auth)

41858 ČERENKOV COUNTER MONITOR FOR SEPARATED BUBBLE CHAMBER BEAMS. Nahmin Horwitz (Syracuse Univ., N. Y.) and Medford Webster. Rev. Sci. Instr., 35: 1525-8(Nov. 1964). (BNL-8112)

The construction and performance of a simple, reliable threshold gas Cherenkov counter is described. When the discrimination level is well below one photoelectron, the counter efficiency rises from 0.1 to 0.9 for a change in particle velocity of $\Delta\beta = 0.0006$. The counter was very useful in setting up and monitoring a separated beam used with the Brookhaven 80-in. bubble chamber. (auth)

41859 KINGDOM CAGE AS A MOLECULAR BEAM DETECTOR. P. R. Brooks and D. R. Herschbach (Univ. of California, Berkeley). Rev. Sci. Instr., 35: 1528-33 (Nov. 1964).

A space-charge detector was constructed to detect beams of neutral molecules. The detector is a diode within which positive ions created by electron bombardment of the beam partially neutralize the space charge and thus produce an increase in the plate current. Beams of rare gases, hydrocarbons, alkyl iodides, nitrogen, and nitric oxide were studied, and the detector is found to be suitable for measurements of total collision cross sections. The increase in plate current is proportional to the beam intensity raised to a power near unit. The response varies with the beam material and the electrode geometry, but is quantitative and reproducible for a given detector. The minimum detectable intensity is about 10^{11} molecules/cm^2/sec. (auth)

41860 USE OF FAST INFRARED EMITTING DIODES WITH SEMICONDUCTOR DETECTORS. G. Amsel and C. Zajde (Université, Paris). Rev. Sci. Instr., 35: 1538-46(Nov. 1964).

The light flash of fast infrared emitting GaAs diodes operated in forward conduction at room temperature was used to excite particle detectors made in silicon. The 9000-Å photons have a range in silicon of 10 μ and create electron-hole pairs, simulating the absorption of a charged particle. The especially designed GaAs diodes can be pulsed with nanosecond speeds. The risetime and decay time of the light flash is less than 0.5 nsec; the time jitter between the current pulse and the light flash is less than 30 psec. The amplitude spectrum of the flash intensity follows Poisson's law applied to the number of photons emitted. The resulting spread is typically of the order of 10^{-3}. A light flash of 1 nsec equivalent to a 5-Mev particle is easily obtained. Transient and statistical characteristics of various types of detectors are quickly measured with high accuracy. The energy calibration of detectors, the adjustment of zero time in complex setups in coincidence, the stabilization of amplifier chains are possible. The coupling of a GaAs diode to a detector yields a high performance fast current integrator. (auth)

41861 AUTOMATIC GAIN CONTROL FOR PHOTOMULTIPLIER TUBES. Jerome A. Rosenthal and Marcel Fiehrer (Univ. of California, Berkeley). Rev. Sci. Instr., 35: 1560-3(Nov. 1964). (UCRL-11450)

When using a photomultiplier to scan photographs of bubble chamber tracks or other dark signals on a light background, the output signal one obtains depends strongly on the intensity of the background. An automatic gain control circuit that helps to remove this dependency is described and analyzed. The circuit is both simple and transistorized. Furthermore, it can adjust its gain within microseconds to a large increase in light background. (auth)

41862 SPARK CHAMBER PULSING SYSTEM. Louis Lavoie, Sherwood Parker, Charles Rey, and Daniel M. Schwartz (Univ. of Chicago). Rev. Sci. Instr., 35: 1567-71 (Nov. 1964).

A spark chamber pulser is described in which several avalanche transistors and a step-up transformer drive directly an air spark gap whose trigger electrode is surrounded by barium titanate dielectric. Output pulses of from 1 to 25 kv with a risetime of 1 nsec and an output impedance of less than 1 Ω can be obtained. The total delay from the 1-v input pulse to the high voltage output pulse ranges from 17 to 65 nsec depending on the desired voltage and the mode of operation of the spark gap. Jitter times are less than 3 nsec. When Elkonite-tipped electrodes are used, the gap life is in excess of 5,000,000 pulses. Methods are given for reducing the delay to less than 25 nsec at 20 kv and the recovery time to less than 200 μsec at 10 kv. (auth)

41863 TOTAL ABSORPTION COINCIDENCE SPECTROMETER. R. P. Grenier and R. R. Samuelson (Air Force Technical Applications Center, Washington, D. C.). Rev. Sci. Instr., 35: 1575-82(Nov. 1964).

A total absorption beta-gamma coincidence spectrometer utilizing anticoincidence shielding is described. The main detector assembly consists of two NaI(Tl) well crystals each 22.9 cm in diameter by 12.7 cm thick. The wells in the crystals are each 5 cm in diameter by 3.8 cm deep. The crystals are positioned to face each other and present a 4π geometry to the source of activity. A 4π beta chamber operated in the Geiger region is positioned inside the wells. A 7.6-cm-thick plastic phosphor serves as an anticoincidence guard. The system may be used in a variety of double and triple coincidence configurations. The responses of the crystals to gamma rays under various coincidence conditions are included. The facile determination of absolute disintegration rates obtainable with this system by using the coincidence technique and detectors that present a uniform sensitivity to the source of activity is discussed. Experimentally determined total gamma efficiency and peak-to-total ratio vs energy curves are presented, and the techniques and isotopes used to obtain them are discussed. In the region from 70 to 2800 kev the 4π crystals have gamma efficiencies ranging from 0.765 to 0.645, respectively, with a max efficiency at 530 kev of 0.895. The peak-to-total ratio ranges from 0.92 at 70 kev to 0.47 at 2800 kev. (auth)

41864 DEWAR SYSTEM TO ATTAIN -140 TO 550°C IN AN NMR CROSSCOIL PROBE. D. S. Schreiber (Northwestern Univ., Evanston, Ill.). Rev. Sci. Instr., 35: 1582-3 (Nov. 1964).

An L-shaped glass Dewar and associated thermometry which will provide temperatures from -140 to 550°C in a conventional NMR crosscoil nuclear induction probe is described. A particular temperature is maintained by streaming hot or cold nitrogen gas around the sample. Details on the relatively simple construction and mounting of the Dewar in the probe and of heating and cooling the nitrogen heat exchange gas are discussed. (auth)

41865 ELECTROMETER FOR IONIZATION CHAMBERS USING METAL-OXIDE-SEMICONDUCTOR FIELD-EFFECT TRANSISTORS. Joseph B. McCaslin (Univ. of California, Berkeley). Rev. Sci. Instr., 35: 1587-91(Nov. 1964). (UCRL-11405)

A pair of unguarded metal-oxide-semiconductor field-effect transistors was used to measure ionization-chamber currents in the range 10^{-15} to 10^{-8} amp. A portable instrument was constructed which has an input leakage current less than 10^{-16} amp. It exhibits a high degree of stability, circuit simplicity, ruggedness, low drift, and 0.7-mamp drain, which will permit continuous operation for several months. Also, guarded MOS devices, investigated for this application, were found to have leakage currents in the region of 10^{-18} amp. (auth)

41866 HIGH PRESSURE MICROWAVE CAVITY FOR USE IN MAGNETIC RESONANCE. R. G. Goodrich, Glen E. Everett, and A. W. Lawson (Univ. of California, Riverside). Rev. Sci. Instr., 35: 1596-7(Nov. 1964).

A sapphire cone terminated at the large end with a metallic sample serves simultaneously as a pressure seal and the resonant structure for a 1-cm magnetic resonance spectrometer. (auth)

41867 FAST CANCELLATION OF GAMMA RADIATION BACKGROUND PULSES IN HORNYAK BUTTONS WITH AN ACTIVE CIRCUIT. K. G. Proges, A. De Volpi, and P. Polinski (Argonne National Lab., Ill.). Rev. Sci. Instr., 35: 1602-4(Nov. 1964).

A transistorized circuit which eliminates gamma radiation background from the Hornyak button was described. The method relies on fast cancellation of background pulses in contrast to the integration methods described by others. The active unit has more efficient rejection than the passive circuit and has a bandwidth of 200 Mc. With a discriminator that fires on pulses of width ~10 nsec, the useful efficiency for Mev neutrons is more than 60% of that obtainable from processing with integration times in the order of $\frac{1}{2}$ μ sec. The ratio of rejected to accepted ^{60}Co gamma rays is over $10^3:1$. The circuit is useful in any situation where short pulses must be eliminated in favor of longer tailed shapes. (C.E.S.)

41868 HOLDERS FOR AQUEOUS SOLUTION CELLS WHEN USED IN THE VARIAN DUAL EPR CAVITY. Carl Lagercrantz and Lennart Persson (Univ. of Goteborg). Rev. Sci. Instr., 35: 1605-6(Nov. 1964).

Special holders for aqueous solution cells for use in the dual cavity in the Varian EPR spectrometer were designed and constructed. The essential features of these holders are that insertion and removal of the cell can be made with the cavity assembly remaining in the magnet gap and independently of the anterior cell. (C.E.S.)

41869 RECOMBINATION DETECTOR FOR ATOMIC HYDROGEN BEAMS. M. A. D. Fluendy (Harvard Univ., Cambridge, Mass.). Rev. Sci. Instr., 35: 1606(Nov. 1964).

A bolometer detector is described, which, when used with a phase sensitive amplifier, is capable of detecting a modulated H atom beam of 5×10^{10} atoms/cm^2/sec or greater. This detector functions by catalyzing the recombination of H atoms absorbed on the surface of a platinum strip and detecting the temperature rise due to the liberated heat of recombination as a change in the resistance of the strip. (C.E.S.)

41870 HIGH TEMPERATURE NUCLEAR MAGNETIC RESONANCE PROBE. R. L. Odle and C. P. Flynn (Univ. of Illinois, Urbana). Rev. Sci. Instr., 35: 1611-12(Nov. 1964). (COO-1198-170)

An r-f probe was developed which is simple, rugged, and capable of operating at considerably higher temperatures than previously described. The probe assembly consists of two basic parts—a ceramic coil former, which contains the sample chamber and a stainless steel shield enclosing the coil former and fastened to it by three stainless steel screws. The shield serves a variety of purposes. It acts as an r-f screen for the coil and, as a radiation shield, it helps to maintain a uniform temperature distribution in the sample chamber. It also serves as a housing for the r-f leads and automatically positions the sample in the magnetic gap. A thermocouple passes through a hole in the shield and into the coil former, thereby allowing the specimen temperature to be monitored during an experiment. (C.E.S.)

41871 COUNTING 100-V ELECTRONS WITH A CROSSED FIELD ELECTRON MULTIPLIER. Claude S. Leffel, Jr. (Johns Hopkins Univ., Silver Spring, Md.). Rev. Sci. Instr., 35: 1614-15(Nov. 1964).

An electron multiplier tube was developed for studies of the adiabaticity of electron motion in cusped magnetic fields. The electron detector meets the specifications: capable of repeated exposure to the atmosphere, sufficient sensitivity to count single electrons with a high signal-to-noise ratio, a time response of less than 10^{-6} sec, a reasonable sensitivity for electrons with energies of 100 to 1000 ev, and discrimination against secondary electrons with energies below that of the injected electrons. (C.E.S.)

41872 SPECTROMETRIC RESOLUTION OF SCINTILLATION COUNTER USED FOR RECORDING SOFT X RADIATION. V. N. Minaev and V. I. Trefilov. Sb. Nauchn. Rabot Inst. Metallofiz., Akad. Nauk Ukr. SSR, No. 18, 220-1 (1964). (In Russian)

In view of the application of scintillation counters for recording low-energy x radiation, the spectrometric resolving power of a counter possessing a 1-mm thick NaI(Tl) phosphor layer was examined in the low energy region. The characteristic radiation emitted by the x-ray tube was monochromatized, using 2 Ge crystals with a dislocation density of $3 \times 10^3/\text{cm}^2$. The resolving power was defined as the ratio of the peak width ΔE at half-height and the energy E_0 corresponding to the maximum of the curve. The resolving power was determined for iron (Fe $K_{\alpha 1}$), copper (Cu $K_{\alpha 1}$), and molybdenum (Mo $K_{\alpha 1}$) anodes. The values obtained, 44.6, 39.0, and 28.0% respectively, together with the value of 10% for the ^{137}Cs reference standard, indicated that upon decreasing the energy of the x radiation, the resolution becomes worse. This is probably due to the spectrometric worsening of the phosphor. (TTT)

41873 RESOLVING POWER OF THE ELECTROSTATIC-MAGNETIC ENERGY ANALYZER FOR FAST ELECTRONS. H. Boersch, J. Geiger, and W. Stickel (Technische Universität, Berlin). Z. Physik, 180: 415-24 (1964). (In German)

The electrostatic-magnetic energy analyzer consists of a Wien filter (crossed electric and magnetic fields) between two immersion lenses. The energy resolution of the analyzer is calculated. The intensity problem in connection with the generation of a monoenergetic electron beam is discussed, considering anomalous energy spread in high-density beams. With an arrangement containing two analyzers of the same kind, the resolving power is experimentally determined to 0.017 ev. (auth)

41874 DEPENDENCE OF THE REGRESSIVE CAPACITY OF HIGHLY SENSITIVE NUCLEAR EMULSIONS ON THE DURATION OF RIPENING. K. M. Romanovskaya. Zh. Nauchn. i Prikl. Fotogr. i Kinematogr., 9: No. 1, 53-4 (Jan.-Feb. 1964). (In Russian)

The influence of ripening time on image stability in emulsions was studied using emulsions ripened 2 to 6 hr. The results indicate that excessive ripening leads to increased image regression. (R.V.J.)

41875 QUANTUM DETECTION OF MICROWAVE- AND SUBMILLIMETER-WAVE RADIATION BASED ON ELECTRON TUNNELING IN SUPERCONDUCTORS. E. Burstein, D. N. Langenberg, and B. N. Taylor. p.480-95 of "Advances in Quantum Electronics." New York, Columbia University Press, 1961.

The characteristics of M/B/S, S/B/S', and S/B/S structures (B is a metal oxide, M is a metal, and S and S' are superconductors) in the form of sandwiches having composite thicknesses on the order of 100 Å for detecting microwaves and submillimeter waves are studied. Associated circuitry necessary for using these sandwiches as detectors is outlined. (T.F.H.)

41876 PORTABLE ALPHA SCINTILLATION DETECTOR /Q-2101/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1131)

Drawings (4) are presented for a large-area, alpha-survey probe using an RCA 6655 2-in. photomultiplier tube and silver-activated zinc sulfide phosphor. The phosphor is deposited with a thickness of 20 mg/cm^2 on a Lucite plate, which is the light piper. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

41877 PORTABLE ALPHA COUNTER (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1148)

Drawings (6) are presented for a scintillation counter that detects low-level alpha contamination. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

41878 ALARM APPARATUS FOR ALPHA ATMOSPHERIC CONTAMINATION. H. Baron (Commissariat a l'Energia Atomique, Saclay, France). 18p. (CONF-337-28). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

A device for the rapid and continuous detection of α atmospheric contaminations, with sufficient sensitivity for Pu, is described. The device can be used in ventilated and filtered air. A slit impactor makes possible the collection of aerosols larger than 0.5 μ. In numerous cases the major part of the aerosol activity to be controlled comes from dusts larger than this, whereas the solid descendants of Rn and Tn, of smaller size, are eliminated. The collision takes place on a scintillator film that passes before the slit. On the other face of the film, a photomultiplier is placed that gives iterative counting (and alarm release) simultaneously with the collision. The output is approximately 1 m^3/min per sampling head. The apparatus can be constructed of one or several sampling ensembles associated with an electronic recorder. It gives an efficient control of numerous laboratories (particularly those working with Pu) because of the multiplication of the number of sampling points, the relatively high output, the rapidity of its response, and its sensitivity. (tr-auth)

41879 INSTALLATION FOR PERMANENT CONTROL OF THE ATMOSPHERE OF MANY LABORATORIES BY MEANS OF COUNTERS OF LARGE SURFACE. W. Guber (Centre de Recherches Nucleaires, Karlsruhe, Ger.), K. Hogrebe, H. Reker, R. Schubert, and S. Mueller. 11p. (CONF-337-29). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

An installation for the continuous monitoring of 23 work locations, using large-surface counters is described. Its efficiency was tested with radioactive Kr. The electrical control of the installation is discussed. Theoretical and experimental determinations of the sensitivity were made, and the results are reported. (J.S.R.)

41880 IMPROVEMENTS RELATING TO RADIATION DETECTORS. Dennis Allenden, Keith Boddy, David Vernon Freck, and Stanley Ernest Hunt (to Associated Electrical Industries Ltd.). British Patent 969,861. Sept. 16, 1964. Filed Sept. 6, 1961.

A semiconductor detector with alpha particle energy resolution is designed which is particularly useful for detecting Pu and/or U. The detector comprises a reverse biased p-n junction device, an amplifier in the output circuit, a plurality of analyzers each arranged to pass pulses of different pulse height, and switching means for connecting a selected analyzer to a scaler. One of the analyzers may be adjustable over a range of pulse heights. Discriminator and gate circuits which may be used in the analyzers are described. (D.L.C.)

41881 IMPROVEMENTS RELATING TO RADIATION DETECTORS. Dennis Allenden, Keith Boddy, David Vernon Freck, and Stanley Ernest Hunt (to Associated Electrical Industries Ltd.). British Patent 969,862. Sept. 16, 1964. Filed Sept. 18, 1961.

An apparatus is designed for continuously sampling and monitoring air in order to provide immediate indication of an inhalation hazard. The apparatus comprises a semiconductor detector, means for moving a strip of material which has been exposed to the air, and means for analyzing the output from the detector. The material exposed to air is passed to the detector, and the output is analyzed to resolve the alpha energies in order to detect Pu and/or U. The analysis may be carried out by means of selector circuits; discriminator and gating circuits which may be used are described. The detector is further described in British Patent 969,861. (D.L.C.)

ISOTOPE TECHNOLOGY

General

41882 (EUR-1850.e(p.99-111)) EURATOM AND RESEARCH IN THE FIELD OF LABELLED COMPOUND AND RADIOISOTOPES. (European Atomic Energy Community).

Activities in a program to improve the availability of labeled compounds to users in EURATOM are summarized. Improved dissemination of information concerning these compounds is discussed. A list of labeled compounds and producers is included and publications concerning preparation and storage of these compounds are given. Discussions are also included concerning production of new radioisotopes, recovery of fission products, and development of new uses for isotopes. (J.R.D.)

41883 (EUR-1850.e(p.183-93)) ACTIVITY OF THE EURISOTOP BUREAU IN PROMOTING THE INDUSTRIAL, ECONOMIC AND TECHNOLOGICAL USES OF ISOTOPES AND RADIATIONS. G. Proepstl (European Atomic Energy Community).

This activity operates in the technical and economic fields and is concerned also with organization, coordination, and information. Working programs are drawn up in collaboration with experts and organizations in the Community states. A list of research and development contracts is included along with a listing of projects. (J.R.D.)

41884 CARBON-14. Slavko Milenkovic and Smilia Kozomara ("Boris Kidrich" Inst. of Nuclear Sciences, Belgrade). Tehnika (Belgrade), 19: 626-30(1964). (In Serbo-Croatian)

The characteristics of radioactive carbon-14 and the examples of its application in biology, medicine, chemistry, and industry are described. Nuclear reactions for carbon-14 production, chemical methods for its separation from target materials, and radioactivity measurements as well as the elements of safety handling are also discussed. (auth)

Industrial Applications

41885 APPLICATION OF NEUTRON SCATTER TO MEASUREMENT OF THE CONTENT OF BINDER IN ROAD MIXES. R. Lachaud. Ann. Inst. Tech. Batiment Trav. Publ., 17: 83-91(Jan. 1964).

Research on the possibility of measuring the binder content of bituminous mixes through neutron scatter is described. (P.C.H.)

41886 THE APPLICATION OF RADIOACTIVE MATERIALS IN GERMANY. K. Hogrebe and K. Wirtz (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirtschaft, 9: 380-7(Aug.-Sept. 1964). (In German)

Progress in the use of radioactive material in the Federal Republic of Germany from 1958 to 1963 is described. Preparation of radioisotopes, importation of radioactive materials, uses of radiation sources, processing of irradiated materials, instruction and training in the use of radioisotopes, and economic factors are discussed. (M.C.G.)

41887 INDUSTRIAL RADIOGRAPHY WITH GAMMA RAYS. Manuel del Val Cob and Antonio Plata Bedmar (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 7: 35-59(Apr.-June 1964). (In Spanish)

The fundamentals of industrial radiography and its practical application are described. The basic concepts, geometric considerations, radioactive sources, chasis and radiographic film, densitometers, screens, exposure time, operational method, and terminology are discussed. (J.S.R.)

41888 ENZYME-INACTIVATION STUDIES ON IRRADIATION-STERILIZED COD FILLETS. R. O. Sinnhuber and M. K. Landers (Oregon State Univ., Corvallis). J. Food Sci., 29: 190-1(Mar.-Apr. 1964).

As part of a project concerned primarily with the development of an irradiated cod cake, time-temperature heat treatments for inactivation of cod muscle enzymes were determined. Fresh Pacific cod (Gadus macrocephalus) were landed and filleted at Astoria, Oregon, and the fillets were ground to provide a homogeneous sample. The ground cod was stuffed into sausage casing, quick frozen at −18°F, and held at 0°F. Just prior to heat inactivation, the casings were peeled off and the ground sample sliced into cakes which were placed in Mylar (polyethylene) bags, and heated in a hot-water bath to internal temperatures of 150, 160, and 170°F (15, 18, and 21 min, respectively), and held for specified time intervals, of up to two weeks, at 100°F. At the end of each time-temperature period, the bags were placed in a cold-water bath until the internal temperature was 100°F, and the bags were heat sealed, placed in cans, hermetically sealed, and quick frozen at −18°F. They were then shipped under dry ice to the Materials Testing Reactor at Arco, Idaho, for irradiation at 4.5 Mrad, and returned under the same conditions. Irradiation was effected in water maintained at 78°F, and the average dose rate was 4.76×10^6 rad/hr. The samples, were analyzed for increase in amino nitrogen. Release of amino acids was dependent upon pre-irradiation heat treatment, storage time, and storage temperature. According to the results of this experiment, it appeared that a minimal time-temperature treatment of 300 sec at 150°F or 15 sec at 160°F is required prior to irradiation for inactivation of enzymes in cod muscle. (BBB)

41889 APPLICATIONS OF RADIOISOTOPES IN SWITZERLAND. P. Tempus, F. Muenzel, and G. Poretti. Neue Tech., 6: 198-202(Aug. 1964).

Industrial applications of radioisotopes in Switzerland in luminescent paints, measurement of thickness or density, gamma radiography, elimination of electrostatic charges, activation analysis, and production of chemical or biological effects are described. Scientific and medical applications are also discussed. (M.C.G.)

41890 INFLUENCE OF GAMMA RADIATION DOSE RATE ON DECAY OF CITRUS, PEARS, PEACHES, AND ON PENICILLIUM ITALICUM AND BOTRYTIS CINEREA IN VITRO. Louis Beraha (Dept. of Agriculture, Chicago). Phytopathology, 54: 755-9(July 1964).

The presented data demonstrate the influence of a high flux of γ radiation vs a low flux in reducing rate and amount of blue mold rot of oranges (Penicillium italicum), green mold rot of lemons (P. digitatum), brown rot of peaches (Monilinia fructicola), and gray mold rot of pears (Botrytis cinerea). Influence of the dose rate, total dose, and suspending medium on germination and survival of P. italicum and B. cinerea in vitro also was investigated. It was shown that 182 krad delivered at 3 krad/min did not completely control blue mold rot of oranges. At 20 krad/min, however, a range of 157 to 182 krad was effective; at 40 krad/min, the effective dose range was 125 to 137 krad. Within the range 125 to 210 krad, a high flux (12 to 23 krad/min) resulted in lower average infection grades of green mold rot of lemons and a slower rate of decay than a low flux (1.2 to 2.3 krad/min). Effective total dose levels for control of gray mold of pear and peach brown rot were 125 to 150 krad for a high flux of 25 krad/min and more than 200 krad for the low flux of 2.5 krad/min. In Czapek's and Tochinai's media, P. italicum conidia that received a total dose of 100 to 200 krad formed fewer colonies after a high flux of 28 krad/min than after 1.9 krad/min. For B. cinerea conidia, the influence of dose rate on survival was shown only on Czapek's medium. Germination of conidia of both these fungi is influenced, however, by total dose and is independent of rate of application. It is concluded that along with an effective dose range, the dose-rate response of a particular organism-host complex must be established in designating effective pasteurizing levels. A high rate would allow the use of lower total doses to curtail and retard decay than a comparative low flux. (BBB)

41891 UTRWALANIE ŻYWNOŚCI PROMIENIOWANIEM JONIZUJACYM. (Food Preservation by Ionizing Radiation). Wladyslaw Bednarczyk. Warsaw, Wydawnictwo Przemyslu Lekkiego i Spozywczego, 1963. 289p.

The following subjects are considered: fundamental principles of the structure of matter; the physics of ionizing radiation; the interaction of radiation with matter; chemical and biological effects of radiation; application of radiation for the preservation of food, discussing in detail the problems presented by meat and poultry, fish, eggs and egg products, fats and oils, grains and cereals, fruits; methods for improving the quality and increasing the shelf-life of irradiated foods; health problems; nutritional value of irradiated foodstuffs; radiation sources used on industrial scale for the treatment of foods, such as reactors, spent fuels, fission products, and isotopic sources, electron irradiators, Van de Graaff accelerators, linear accelerators, x-ray equipment. Special attention is turned to economic problems, such as cost estimates and to radiation protections. (TTT)

Separation and Production

41892 (BNL-864) MANUAL OF ISOTOPE PRODUCTION PROCESSES IN USE AT BROOKHAVEN NATIONAL LABORATORY. Louis G. Stang, Jr. (Brookhaven National Lab., Upton, N. Y.). Aug. 1964. Contract AT-30-2-GEN-16. 72p.

Techniques for the production of isotopes which require chemical processing after they are formed by irradiation, are described in detail. The isotopes covered by these techniques include: ^{28}Al, ^{38}Ar, ^{67}Cu, ^{18}F, ^{68}Ga, ^{124}I, ^{132}I, ^{133}I, ^{28}Mg, ^{99}Mo, ^{43}K, ^{48}Sc, ^{87m}Sr, ^{99m}Tc, ^{132}Te, ^{128}Xe, and ^{90}Y. (D.L.C.)

41893 (NP-14200) DE SCHEIDING VAN ZWARE ISOTOPEN IN EEN CENTRIFUGAAL VELD. (The Separation of Heavy Isotopes in a Centrifugal Field). J. Los (Leiden. Rijksuniversiteit). 1963. 100p.

The separation of heavy isotopes by means of a centrifuge is studied. The experimental and theoretical work done on centrifuges is reviewed. The cascade theory as developed by Cohen is summarized, and the column theory is discussed. The theory of the countercurrent centrifuge is then considered. Several profiles are treated to show how the discrepancy between the optimal and actual flow leads to severe losses of separative power. Some hydrodynamic aspects of the countercurrent centrifuge are discussed. The experimental results of Groth and Zippe are briefly described. (J.S.R.)

41894 (SGAE-IB/IA-3/1964) HERSTELLUNG UND VERWENDUNG DES RADIONUKLIDS ^{130}JOD. (Preparation and Use of Radioisotope ^{130}Iodine). R. Bauer, K. E. Duftschmid, and H. Sorantin (Österreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf, Austria). [1963]. 13p. (SGAE-CH-5/1964)

The preparation reaction and decay scheme of ^{130}I was studied. ^{130}I was produced in a reactor by neutron reactions (n,γ) with ^{129}I a fission product from uranium with a long half life. The ^{129}I could also be produced by irradiation of tellurium. The gamma spectrum of ^{130}I was determined. Methods of chemical separation and purification were developed. Properties of the isotope for use in radiotherapy and radiodiagnosis are discussed. (M.C.G.)

41895 (AEC-tr-6479) DEVICE FOR THE SEPARATION OF ISOTOPES IN THE GAS PHASE. Erich Bagge, Kurt Diebner, and Hans-Udo Wrobel. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn., from German Patent 1,092,448, Nov. 10, 1960. 7p.

German Patent 1,058,024 describes an isotope gate with cold traps between rotating diaphragms. In this isotope gate, reflection of gas molecules occurs at the diaphragm system with resulting contamination of the enrichment chamber. This is prevented by providing two fixed diaphragms, one on each side of the rotating diaphragms, and by designing the cold traps as an annular cylinder with slits arranged so that only the theoretical path is open to the isotope mixture. (D.L.C.)

41896 PRODUCTION OF Np^{237} AND Pu^{238} IN THERMAL POWER REACTORS. D. R. Vondy, J. A. Lane, and A. T. Gresky (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem., Process Design Develop., 3: 293-6(Oct. 1964).

The production of ^{237}Np and ^{238}Pu was calculated for present-generation reactors. Results indicate that ^{237}Np production now averages about 3 kg per year per 1000 Mw(th) (at 0.8 plant factor); it was estimated that 100 kg per year would be produced in 1975. Because the ^{238}Pu capture cross section is about three times that of ^{237}Np, high efficiency for conversion of ^{237}Np to ^{238}Pu requires removal of the product after relative short exposures. The maximum conversion of ^{237}Np to ^{238}Pu in a single exposure is about 20%, but by recycling the Np, over-all conversion of 50 to 60% can be realized. (auth)

41897 RESEARCH OF RADIOISOTOPE PRODUCTION WITH FAST NEUTRONS. V. TRIAL PREPARATION OF CARRIER-FREE ^{65}Ni. Eiji Shikata (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 1: 137-40(July 1964).

The preparation of carrier-free ^{65}Ni was studied using the reaction ^{65}Cu(n,p)^{65}Ni in a nuclear reactor. High purity copper metal was irradiated for 20 min in the JRR-2 reactor. Nickel-65 formed in the copper target was separated by anion exchange method. About 1 μC ^{65}Ni per gram of copper was obtained by irradiation with a fast neutron flux of 9×10^{11} n/cm^2/sec and thermal neutron flux of 3.6×10^{13} n/cm^2/sec. The specific activity was greater than 3 mC/mg Ni which was over 600 times more than that produced by (n,γ) reaction on nickel irradiated at the same time. However, the reaction yield of ^{65}Ni per gram of target by the (n,p) reaction was only $\frac{1}{5000}$ of that by the (n,γ) reaction, so that it proved that the method would be unsuitable for practical application. The cross section for the reaction ^{65}Cu(n,p)^{65}Ni has been estimated semi-theoretically to be

0.6 mb, an experimental value of 0.2 mb was calculated. (auth)

41898 AN IMPROVED TECHNIQUE FOR THE PREPARATION OF O^{17} TARGETS. A. H. F. Muggleton and C. T. Parsons (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 27: 357(July 1964).

A method of producing thin films containing ^{17}O, suitable for nuclear spectroscopy, is described. Tungsten oxide, enriched in ^{17}O, was obtained by chemical reaction between a heated tungsten filament and ^{17}O gas. The oxide was then evaporated on thin carbon backings. (M.C.G.)

41899 THE FRINGING FIELD FOCUSING RADIOISOTOPE SEPARATOR AT CERN. PART I. DESIGN AND CONSTRUCTION. G. Andersson, B. Hedin, and G. Rudstam (CERN, Geneva). Nucl. Instr. Methods, 28: 245-54(Aug. 1964).

An isotope separator designed primarily for the study of radioactive products formed in high-energy nuclear reactions is described, which uses a fringing field focusing principle. A parallel beam enters a homogeneous sector field at right angles. After a deflection of 55°, the central beam (radius 1 m) leaves the magnet at 35.3° to the normal of the edge, resulting in coinciding horizontal and vertical focusing at a distance from the magnet boundary of $\sqrt{2}$ times the radius. The necessary fringing field shape is realized by means of iron flanges at about an air gap's distance from the magnet edges. (auth)

41900 THE FRINGING FIELD FOCUSING RADIOISOTOPE SEPARATOR AT CERN. PART II. PERFORMANCE. G. Rudstam, S. Sundell, and G. Andersson (CERN, Geneva). Nucl. Instr. Methods, 28: 255-9(Aug. 1964).

The horizontal and vertical intensity distributions of samples separated by the separator were determined. The focusing properties of the separator were investigated, together with the dispersion over the whole mass range covered. (D.C.W.)

41901 PRODUCTION OF ^{10}B BY EXCHANGE DISTILLATION OF THE COMPLEX $(CH_3)_2O\cdot BF_3$. V. A. Vlasenko, I. G. Gverdtsiteli, Yu. V. Nikolaev, and E. D. Oziashvili. Soobshch. Akad. Nauk Gruz. SSR, 33: 79-84(1964). (In Russian)

An apparatus for the production of ^{10}B by exchange distillation of $Me_2O\cdot BF_2$ is described. The output of the device is 10 g B/day with a concentration of 80% ^{10}B. In the exchange distillation the isotopic effect of the exchange reaction between gaseous BF_3 and the liquid complex $Me_2O\cdot BF_2$ is used. The separation of the B isotopes is carried out in the usual rectification columns, where the turnover of the phases is brought about by the evaporation of the liquid phase and the condensation of the gaseous phase. ^{10}B is concentrated in the liquid phase. The isotopic exchange takes place by the reaction $Me_2O\cdot {}^{11}BF_2 + {}^{10}BF_2 \rightleftharpoons Me_2O\cdot {}^{10}BF_2 + {}^{11}BF_2$. The equilibrium constant of the reaction at 100° is K = 1.027. At this temperature the degree of dissociation of the complex in the vapor phase $Me_2O\cdot BF_3 \rightleftharpoons BF_3 + Me_2O$ is only 60%. The effective separation coefficient is less than the equilibrium constant, 1.016. The complex $Me_2O\cdot BF_2$ is thermally unstable, and its decomposition takes place by the reaction $3Me_2O\cdot BF_3 \rightleftharpoons (MeO)_3B\cdot 2BF_3 + 3MeF$. The rate of thermal decomposition is 1%/day. The decomposition products should be continuously eliminated from the column. The column consisted of 2 sections, for enrichment and exhaustion and had a total height of 14.9 m. An adiabatic process was ensured by surrounding the column with electric furnaces. The column is fed by evaporation of the complex with subsequent condensation and recording of the number of drops with a counter. The pressure is maintained at 150 mm. The complex is obtained by the reaction $Me_2O + BF_2 \rightleftharpoons Me_2O\cdot BF_3$. A complex with a ^{10}B concentration of 16% is used for feeding, and a final concentration of 95.3% ^{10}B is thus attained. (P.C.H.)

41902 ISOTOPE SEPARATION BY THE ION MOBILITY METHOD. I. THE IDEAL PARTITION COLUMN. B. P. Konstantinov and V. B. Fiks (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Fiz. Khim., 38: 1647-51(June 1964). (In Russian)

Optimum conditions for isotope separation processes in columns and the mechanism of isotope ion motion and separation in solutions were studied. Differential equations were developed for separation of binary isotope mixtures in the column. (R.V.J.)

41903 SEPARATION OF HYDROGEN ISOTOPES IN AQUEOUS SOLUTIONS OF HYDROCHLORIC ACID. E. A. Bakulin and E. V. Stepin. Zh. Fiz. Khim., 38: 1655-6 (June 1964). (In Russian)

The construction of a column for hydrogen isotope separation from aqueous acid solutions using the ion mobility method is reported. The separation of hydrogen isotopes in hydrochloric acid showed a shift from 0.16 to 0.28% in deuterium composition during the solution concentration change from 3.2 to 10.3 $\underline{N}$. The method proved efficient for studying hydrogen isotope exchange in acid solutions. (R.V.J.)

41904 METHOD OF DOUBLE SIMULTANEOUS CENTRIFUGATION, MEANS EMPLOYED AND PRODUCTS THUS OBTAINED. G. A. Rabissow. French Patent 1,330,152. May 13, 1963. Filed Feb. 15, 1962.

The construction of an apparatus in which material to be separated is simultaneously subjected to two different centrifugal forces is described. The apparatus consists of a container that rotates on two different axis. During centrifugation the material can be ionized and the ionized particles subjected to a magnetic field. The apparatus is particularly useful for separating H and U isotopes. (NPO)

MATHEMATICS AND COMPUTERS

Refer also to abstract 41769.

41905 (AROD-3083.14) GENERAL FOURIER AND SUPERPOSITION FOURIER PROGRAMS (CDC 1604). Technical Report No. 3. Robert A. Jacobson (Princeton Univ., N. J. Frick Chemical Lab.). Aug. 1964. 41p.

The Fourier program is designed to compute electron density, or Patterson maps, or other similar Fourier functions using relatively small amounts of computing time. Maps can be computed in intervals of 24 0ths of the unit cell or larger, and the output is in two-character coded format, modular 1024. The superposition Fourier program is designed to superimpose Patterson maps using BC tape images in a buffered fashion and output the resultant map in coded and BC formats. The average computation time is 3 to 5 minutes. (auth)

41906 (CEA-R-2100) SUR LA STABILITE, LES SOLUTIONS PERIODIQUES ET LA RESOLUTION DE CERTAINES CATEGORIES D'EQUATIONS ET SYSTEMES D'EQUATIONS DIFFERENTIELLES COUPLEES NON LINEAIRES APPARAISSANT DANS LES OSCILLATIONS BETATRONIQUES. (On the Stability, the Periodic Solutions, and the Resolution of Certain Types of Non Linear Equations, and of Non Linearly Coupled Systems of these Equations, Appearing in Betatronic Oscillations). Jean Valat (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1964. 135p.

Thesis submitted to Universite, Paris.

Universal stability diagrams were calculated and experimentally checked for Hill-Meissner type equations with square-wave coefficients. The study of these equations in the phase-plane made it possible to extend the periodic solution calculations to the case of non-linear differential equations with periodic square-wave coefficients. This theory was checked experimentally. For nonlinear coupled systems with constant coefficients, a search was first made for solutions giving an algebraic motion. The elliptical and Fuchsian functions solve such motions. The study of non-algebraic motions is more delicate, apart from the study of non-linear Lissajous' motions. A functional analysis shows that it is possible in certain cases to decouple the system and to find general solutions. For non-linear coupled systems with periodic square-wave coefficients it is then possible to calculate the conditions leading to periodic solutions, if the two non-linear associated systems with constant coefficients fall into one of these categories. (auth)

41907 (HW-SA-3465) A COMPUTER PROCESSING CONTROL SYSTEM. M. B. Bauder (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1, 1964. Contract AT(45-1)-1350. 29p. (CONF-671-1)

From Data Processing Management Association Joint Computer Conference, Richland, Wash., Apr. 1964.

The processing control system for the business programming of the HAPO IBM 7090 is described. (R.E.U.)

41908 (ORNL-P-310) A STUDY OF SOLUTIONS OF BESSEL'S EQUATION. Joseph Lewis Hosszu (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract [W-7405-eng-26]. 67p.

Thesis submitted to Univ. of Tennessee, Knoxville.

The solution of Bessel's equations is treated with a view to wider use of the equations in problems of mathematical physics which involve either cylindrical or spherical geometry. It is shown that derivation, explanation, application, and some numerical calculation can be carried out without sacrificing either clarity or brevity. Models are developed to present a visual display of the function, and their resemblance to some shapes encountered in experimental physics is pointed out. Bessel function tables are presented which give values of the various orders for integral values of the radial components. (D.L.C.)

41909 (UCRL-7823) MONTE CARLO METHODS—A BIBLIOGRAPHY COVERING THE PERIOD 1949 TO 1963. Rose Kraft and Carl J. Wensrich (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 1, 1964. Contract W-7405-eng-48. 113p.

A listing of 743 titles is presented alphabetically according to the author designation. The bibliography supersedes UCRL-6581 (NSA, 16: 4445). (R.E.U.)

41910 (ANL-Trans-60) MINICH. PROGRAM FOR MINIMIZATION OF FUNCTIONS. W. Pfeifer and J. Rognon. Translated for Argonne National Lab., Ill., from New Tech., 5: 725-31(1963). 15p.

A program in FORTRAN II was written and tested. This program MINICH, which seeks the minimum of an analytic function (subprogram FONCT) of N variables, is particularly adapted to functions of a complicated character whose computation requires much machine time. The intention being to calculate the least possible number of functional values, the time used for this relatively complicated method is not important. To avoid unnecessary computation an upper and lower bound should be known for each variable. The program is explained with the help of the flow-diagram and an example is given to show its application. (auth)

41911 EXPERIMENTAL DETERMINATION OF THE LAPLACIAN FOR THE PROGRESSIVE SUBSTITUTION METHOD. E. Rodriquez Mayquez and J. L. de Francisco Sainz (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 7: 60-5(Apr.-June 1964). (In Spanish)

Two experimental methods can be used for the determination of the Laplacian: the exponential and the critical experiment. The advantages and disadvantages of each are compared. The progressive substitution method is then described. (J.S.R.)

41912 LINKED-CLUSTER THEOREM AND UNITARITY. Robert Yaris (Univ. of Minnesota, Minneapolis). J. Chem. Phys., 41: 2419-21(Oct. 15, 1964).

It is shown that the linked-cluster theorem for nonperturbational treatments (previously demonstrated) follows from the principle of unitarity (conservation of probability). The reasons why unlinked clusters appear in CI calculations, but can be canceled out of the results is also briefly discussed. (auth)

41913 DISTRIBUTION MEASUREMENT ERRORS DUE TO THE PILE-UP EFFECT. B. Soucek (Institut "Rudjer Boskovic," Zagreb). Nucl. Instr. Methods, 28: 306-8(Aug. 1964).

At high event occurrence rates, the measured distributions deviate from the original distributions because of the errors due to the pile-up effect. The distribution measurement errors are calculated and plotted as a function of the pulse form parameters and the average rate and amplitude distribution of the input events. The change of the mean value, standard deviation, factors of skewness and excess, and, especially, the change of the mode value (spectrum peak) of the measured distribution are considered. The normalized forms of the calculated curves suitable for direct applications are given. (auth)

41914 UPPER AND LOWER BOUNDS FOR RAYLEIGH-SCHRÖDINGER PERTURBATION ENERGIES. Kenneth M. Sando and J. O. Hirschfelder (Univ. of Wisconsin, Madison). Proc. Natl. Acad. Sci. U. S., 52: 434-46(Aug. 1964).

Variational principles are given for both the upper and lower bounds of the even-order energies for both single and double perturbation problems. (D.C.W.)

41915 FUNCTIONAL AVERAGES IN THE STATISTICAL THEORY OF QUANTUM MECHANICAL AND CLASSICAL SYSTEMS OF MANY PARTICLES. Johannes Zittartz (Universität, Cologne). Z. Physik, 180: 219-54(1964). (In German)

The grand-canonical partition function of an interacting many-particle system is represented as a functional integral with Gaussian random variables. The representation can be regarded as a Gaussian average over the partition function of free particles in an external fluctuating potential. The latter partition function is studied using diagrammatical techniques. The set of diagrams of a particularly simple structure is summed up by introducing the full scattering amplitude for the scattering in the external potential. The thermodynamical Gibbs' potential proves to be stationary with respect to the true particle density. It is shown that a variational procedure leads directly to an approximation, which may be regarded as the renormalized form of the well-known random-phase approximation (RPA). The main feature of the approximation is that Gibbs' potential is stationary with respect to the two-particle density correlation function. The classical limit of the renormalized RPA yields the results of the Debye-Hückel theory. In the case of a hard-core potential, the approximation applies only to the long-range part of the potential. The results are similar to recent developments in the theory of the Ising model and of real gases. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstracts 41686, 42162, and 42348.

41916 (AD-604409) SOLUBILITY OF H IN Zr AT ROOM TEMPERATURE AND PROPERTIES OF THE SOLID SOLUTIONS. Technical Report No. 9. M. E. Straumanis and D. H. Wiebe (Missouri. Univ., Rolla. School of Mines and Metallurgy). Aug. 1964. Contract Nonr-2296(03). 33p.

The $\alpha-ZrH_x$ samples were prepared from reactor grade zirconium hydride by decomposing it in a hydrogen atmosphere at various temperatures between 750 and 1000°C and by slowly cooling them to room temperature in vacuum. The solid solubility limit of H in $\alpha-Zr$ in such samples was 310 ppm at room temperature, determined by the parametric x-ray method. About the same solid solubility limits (280 ppm) could be derived from the increase of tensile and yield strength of Zr wires with increasing content of H; within the solid solubility range the strength of the wires increased only slightly but increased strongly in the two-phase region. The solubility limit mentioned may also represent the H-solubility at 375°C, as it is virtually impossible to remove the H from the Zr below that temperature. This feature explains the discrepancy with thermodynamic measurements, which give only 10 ppm of H solubility at room temperature. However, lattice parameter plots showed that no other phase segregated from ZrH_x solid solutions up to concentration of 310 ppm H. It was found that the a-constant of pure Zr increases from $a_{25} = 3.2360$ to 3.2378 Å for Zr containing 310 ppm H in solid solution, and the c_{25} constant—from 5.1508 up to 5.1572 Å respectively. Beyond 310 ppm H both constants did not change. The thermal expansion coefficients of $\alpha-ZrH_{0.011}$ (containing 122 ppm H) between 15 and 55°C are: $\alpha_a = 4.6 \times 10^{-6}$ and $\alpha_c = 11.0 \times 10^{-6}$ $°C^{-1}$. The density of pure Zr was found to be 6.481, while the x-ray density was 6.4840 g cm^{-3} at 25°C. The experimental density decreased with increasing H-content more strongly than the x-ray density. This result points toward the increase of vacancy aggregations while the H is absorbed in the $\alpha-ZrH_x$. If these aggregations are noted in terms of vacant sites, then their number increases from nearly zero (for pure Zr) up to 0.014 sites/unit cell for Zr saturated with H. At a certain excess of H, the vacancy clusters may serve as nucleation centers for the hydride phase. As this phase occupies a larger space than the matrix, from which the former is formed, microcracks may appear in the solid solution, causing the hydrogen embrittlement of the latter. The pile-up of dislocation may have the same effect. (auth)

41917 (AWRE-O-58/64) THE CORROSION AND IGNITION BEHAVIOUR OF SOME URANIUM–PLUTONIUM–IRON ALLOYS. G. Picton and J. F. Sackman (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Aug. 1964.

The corrosion and ignition behavior of uranium–plutonium alloys containing 4, 6, and 8 at.% iron has been studied. All ignited in air between 100 and 315°C and only chill cast specimens showed good corrosion resistance when exposed to moist air. (auth)

41918 (BM-RI-6527) A PROCESS FOR THE PREPARATION OF THORIUM BY SODIUM REDUCTION OF THORIUM TETRACHLORIDE. H. O. Poppleton and F. E. Block (Bureau of Mines, Albany, Ore.). 1964. 23p.

This investigation was made to develop a method of preparing high-purity thorium metal in quantities up to 20 kilograms per batch. Several methods for the preparation, purification, and reduction of thorium tetrachloride are discussed. Thorium tetrachloride was prepared by chlorination of decomposed thorium nitrate or oxalate with carbon tetrachloride or phosgene. Purification of the crude tetrachloride was achieved by multiple distillations or by filtration of the molten chloride. It was found that high-purity thorium metal could be prepared by sodium reduction of thorium tetrachloride if chloride of sufficient purity were available. Byproduct salts and excess reductant were removed by vacuum distillation, and the resultant thorium metal sponge was consolidated by consumable-electrode or fixed-electrode arc melting. It was demonstrated that metal prepared by this method could be fabricated into bar, rod, or sheet, at room temperature. (auth)

41919 (BMI-1689) STUDIES IN THE UO_2-ZrO_2 SYSTEM. Thomas R. Wright, Donald E. Kizer, and Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Aug. 27, 1964. Contract W-7405-eng-92. 36p.

Densification and homogenization of compacted ball-milled powders were accomplished by sintering from 10 to 15 hr at 1700°C or from 15 to 20 hr at 1600°C in flowing dry hydrogen. Homogeneous fuel pellets with densities in excess of 97 per cent of theoretical were obtained for property studies. The thermal-conductivity of the UO_2–50 mole per cent ZrO_2 composition was found considerably lower than that of UO_2 but higher than that of ZrO_2. The linear-thermal-expansion curve roughly paralleled that of pure UO_2, at a slightly higher value, over the temperature range measured. Electrical resistivity decreased with increasing temperature, as is typical of a ceramic material. In tests of UO_2–20 to 50 mole per cent ZrO_2 compositions, in general, both room-temperature and high-pressure hardness values increased as the ZrO_2 content increased. Homogeneous UO_2–50 mole per cent ZrO_2 pellets were more resistant to cracking under thermal cycling than were inhomogeneous pellets of the same composition. Phase relationships in the UO_2-ZrO_2 system up to 50 mole per cent ZrO_2 were evaluated to determine as a function of temperature the equilibrium phases present and the solubility limits of ZrO_2 in UO_2. At 1000°C or above it was found that, at low ZrO_2 contents, a single-phase face-centered-cubic solid-solution region is present. At ZrO_2 contents greater than 13.5 mole per cent a two-phase face centered cubic-face centered tetragonal region exists at 1000°C. This two-phase region disappears above 1750°C. (auth)

41920 (COO-1198-204) DIFFUSION IN BCC TRANSITION METALS— A THEORETICAL CRITIQUE. David Lazarus (Illinois. Univ., Urbana). [1963]. Contract AT(11-1)-1198. 32p. (CONF-691-1)

From Conference on Fusion of Body-Centered Cubic-Materials, Gatlinburg, Tenn., Sept. 1964.

The diffusional behavior of the bcc transition metals has been compared with basic theoretical models to establish which of the observed effects may be considered as truly anomalous. The following facts appear to be inconsistent with theory at least for a simple vacancy mechanism: 1) Excessively small or excessively large values of the frequency factory D_0, as found in Ti, Zr, U, and W. 2) Large variations of D_0 and Q with temperature, as found for Ti, Zr, and U. 3) Observed increases in diffusion coefficients with hydrostatic pressure. 4) Large differences between rates of diffusion of fast-diffusing solute atoms and solvent atoms. However, the basic validity of the theoretical models has not yet been established for the bcc transition metals, and, in particular, a) the presence of unfilled d-shells gives at least the possibility that the reaction rate theory may have to be considerably modified to account for possible changes in electronic configuration of atoms during diffusion; and b) theories of impurity diffusion may have to take account of possible screening by bound states. In addition, the mass dependence of diffusion must be measured for the bcc metals before the vacancy mechanism can be clearly established. Finally, it is noted that the strikingly large values observed for self-diffusion at high temperatures correlates strongly with the observed large solubility and low vapor pressures for dissolved atmospheric gases in Ti, Zr, and possibly U, so that the reported "anomalous" diffusional behavior in these elements may not be truly characteristic of the pure materials. (auth)

41921 (GEMP-37A) HIGH-TEMPERATURE MATERIALS PROGRAM. Progress Report No. 37, Part A. (General Electric Co. Advanced Technology Services, Cincinnati). July 31, 1964. Contract AT(40-1)-2847. 56p.

Creep-rupture data on W were compiled from tests conducted in H_2 and Ar atmospheres at 2200 and 2600°C and compared with data previously obtained from other sources of material. Comparative creep-rupture studies on Re, W–25Re, and Ta–10W were conducted in H_2 at 1600, 2200, and 2600°C. Fabrication and alloy development studies on W–25Re and W–Re–Mo alloys were continued. A marked improvement in the room-temperature ductility of W–25Re alloy was obtained from specimens processed from high-purity (wet-H_2 treated) powders. Creep-rupture testing of irradiated W specimens at 1100°C indicates that the apparent incubation period is strongly dependent on stress and irradiation doses. This effect may be attributed to dislocation pinning and to the impediment of dislocation motion through the large number of radiation-induced obstacles, such as small vacancy clusters and dislocation loops. Creep-rupture testing of irradiated W specimens at temperatures of 1400, 1500, and 1700°C indicates that a consistent increase in the time to rupture and the corresponding decrease in the minimum creep rate may be caused primarily by the W → Re transmutations through the thermal neutron (n,γ) reaction. Resistivity increases in W caused by irradiation appear to recover with peaks occurring primarily at 0.15, 0.22, and 0.31 T_m. The first peak was identified as obeying second-order kinetics and the last peak as obeying first-order kinetics. At the present time the resistivity recovery mechanisms are attributed to interstitial, di-vacancy, and vacancy migrations for the 0.15, 0.22, and 0.31 T_m recovery peaks, respectively. Microhardness studies on irradiated W-single-crystals indicate that room-temperature hardness is only slightly affected by the irradiation. The temperature-insensitive hardness component, which becomes prominent at temperatures greater than 280°C, results in a 60% increase due to the irradiation and persists up to temperatures of approximately 1000°C. The hot hardness is essentially recovered with the exception of the residual hardness due to the presence of Re atoms at a temperature of approximately 0.35 T_m. This 0.35 T_m is in good agreement with the yield strength recovery observed in neutron-irradiated Mo, Nb, and α-Fe. Results of the shielded-unshielded experiments indicate that thermal neutrons significantly affect the creep-rupture properties of irradiated A-286 alloy. In addition, calculations show that grain-boundary segregation of B may result in grain-boundary B concentrations which are several orders of magnitude higher than that present within the matrix. The presence of the natural B with its high thermal neutron cross section isotope is believed to be indirectly responsible for the elevated-temperature embrittlement observed in these high-temperature alloys. (auth)

41922 (HW-68600-42) PLUTONIUM ABSTRACTS. Volume 4, Number 8. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1, 1964. Contract AT(45-1)-1350. 18p.

A total of 21 abstracts is presented on new developments in plutonium technology. The abstracts are arranged under the subject headings: Biology and Medicine, Chemistry, Metallurgy and Ceramics, and Physics. (D.L.C.)

41923 (HW-82436) GRAPHITE BURNOUT MONITORING. PART I. MONITOR PREPARATION AND HANDLING TECHNIQUES. B. A. Ryan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1964. Contract AT(45-1)-1350. 35p.

The preparation and handling of samples (0.43 in. dia and 3.9 in. long) for use as graphite burnout monitors in Hanford reactors are described. (R.E.U.)

41924 (IITRI-578P19-13) ALLOYING CHARACTERISTICS OF THE RARE EARTH ELEMENTS WITH THE TRANSITION ELEMENTS. Final Report, March 15, 1962–April 30, 1964. Rodney P. Elliott (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Contract AT(11-1)-578. 35p.

The alloying characteristics of the rare earth elements with the transition metals undergo a radical change as the atomic number of the transition series increases—transition elements in Groups IVa, Va, and VIa are immiscible with the rare earths, while elements of Groups VIIa, VIIIa, VIIIb, and VIIIc form many compounds. Since this cannot be correlated with a size effect, a reasonable explanation for this behavior is a valency or electronegativity effect. Those binary systems forming compounds form Laves phases, which can exist in one of three related crystal structure types: $MgCu_2$, $MgZn_2$, or $MgNi_2$. The specific Laves-type crystal structure can be related to the average free electron concentration, a phenomenon which was used to calculate electronic valency of the transition elements. A compilation of the known Laves-type phases occurring between rare earth elements and transition metals supports the hypothesis that the valency effect is operative. Forty-two additional rare earth-transition metal compounds previously unknown were prepared and found to be consistent with the previously noted trend with but two exceptions. On the assumption that a critical electron/atom ratio determines which Laves-type structures are stable, the periodical grouping of the Laves-type species of the rare earth-transition metal compounds indicates a slight but regular increase in valency as the atomic number of the rare earth increases. Ternary alloys prepared between the Laves phases of different structure types substantiate the observed valency trend. (auth)

41925 (IITRI-B241-8) FIBER-REINFORCED METALS AND ALLOYS. Final Report, April 4, 1962–September 3, 1963. K. Farrell and N. M. Parikh (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Aug. 31, 1963. Contract NOw-62-0650-c. 36p. (AD-418757)

Attempts to produce high-strength low-weight fiber composites from beryllium fibers and aluminum matrix materials are described. The principles of fiber metallurgy strengthening are outlined, and the difficulties encountered in the Al–Be fiber system are described and discussed. It is concluded that the presently available beryllium fibers are unsuitable for fiber reinforcement purposes. (auth)

41926 (MAB-201-M) PROCEDURES FOR EVALUATING COATED REFRACTORY METAL SHEET. (National Research Council. Materials Advisory Board). Aug. 3, 1964. 40p.

Supersedes MAB-189-M.

A set of test procedures are defined which enables comparisons of coating systems for refractory metals to be made. The procedures include both screening tests (developed in the original edition) and advanced procedures. Among the properties studied in the procedures are oxidation, bend transition temperature, reproducibility, compatibility, tensile properties, stress rupture, creep, and fatigue. (D.L.C.)

41927 (MLM-1199) REACTOR FUELS AND MATERIALS DEVELOPMENT—PLUTONIUM RESEARCH, JANUARY–MARCH 1964. L. J. Wittenberg and G. R. Grove (Mound Lab., Miamisburg, Ohio). Mar. 31, 1964. Contract AT-33-1-GEN-53. 18p.

The portion of the plutonium–cerium–nickel system containing 0 to 50 at. % Ni was investigated. Plutonium and cerium form delta plutonium and gamma cerium solid solution phases; CeNi and PuNi form a continuous solid solution; and the compound Ce_5Ni_2 forms a terminal solid solution of ternary composition. Investigation of a single crystal of Ce_5Ni_2 indicates that it may be related to Ce_7Ni_3. Investigation of the plutonium–cerium–iron system revealed the existence of a quasi-binary system between Ce and $PuFe_2$ which divides the phase diagram into two subsystems, Pu–Ce–$PuFe_2$ and Ce–Fe–$PuFe_2$. The Pu–Ce–$PuFe_2$ subsystem contains a ternary eutectic at 410°C and a wide range of moderately low melting compositions. Investigation of the cerium–iron binary system revealed wide disagreement with the phase diagram given in the literature. The shape of the liquidus line was particularly modified. In the presence of iron, beta cerium rather than gamma cerium was found to be stable at room temperature. Analyses of oscillation and Weissenberg photographs of a single crystal of the compound $PuCu_4$ indicate that the unit cell is orthorhombic with cell parameters of a = 10.06 A, b = 8.16 A, and c = 5.14 A. The measurement of the density of molten cerium was extended to 1173°C, where a value of 6.556 g/cc was obtained. The observation that cerium expands as it solidifies was confirmed. The technique for the measurement of vapor pressure by differential thermal analysis was extended to zinc at 7 to 200 mm Hg. The viscosity of a Pu–1 wt % Ga alloy decreased from 8.72 centipoise at 672°C to 6.34 centipoise at 816°C. The liquidus temperature for the alloy was 669°C. The viscosity of a 49.4 at. % Pu–50.6 at. % Ce alloy decreased from 5.64 centipoise at 750°C to 4.43 centipoise at 906°C. The viscosity near the melting point, 721°C, was above that of either plutonium or cerium. A technique was devised for sintering oxide PuO_2 feed material. When this feed material was introduced into the plasma torch, microspheres were produced. X-ray-diffraction photographs of microspheres composed of 50 wt % PuO_2–50 wt % BeO revealed that they were composed of well-formed crystals of the constituent oxides, although optical microscopy indicated that the spheres were single phase. (auth)

41928 (NASA-CR-54089) RESEARCH AND DEVELOPMENT PROGRAM ON MAGNETIC, ELECTRICAL CONDUCTOR, ELECTRICAL INSULATION, AND BORE SEAL MATERIALS. Third Quarterly Report, March 1, 1964–May 30, 1964. P. E. Kueser, et al. (Westinghouse Electric Corp., Pittsburgh and Eitel-McCullough, Inc., San Carlos, Calif.). Mar. 1964. For Westinghouse Electric Corp. Aerospace Electrical Div., Lima, Ohio. Contract NAS3-4162. 171p. (N64-25010)

Design information on electrical materials suitable for application to space electric power systems is evaluated. The program data are based upon some literature sources but the majority are based on tests. Mechanical tests have shown that high-saturation materials such as iron–cobalt are not suitable for high-stress applications at elevated temperature. The 50 Co-50 Fe material also undergoes atomic ordering at elevated temperature, thereby increasing the coercive force. Nivco (23 Ni–1.1 Zr–1.8 Ti–Co) has the best creep properties of potential rotor materials above 900°F. Several dispersion-strengthened copper conductors were developed as well as austenitic stainless steel-clad conductors. Weight-loss tests on insulations in vacuum have shown the importance of prior treatment on material performance since all samples showed a high initial loss rate which later tapered off. Ceramic-to-metal seals using high purity ceramics and silica-free metalizings appear to be marginal in strength. Emphasis is now being placed on active metal brazing methods for fabricating ceramic-to-metal seals. (auth)

41929 (NP-14221) GALLIUM. BULLETIN BIBLIOGRAPHIQUE 1964. (Gallium. Bibliographic Bulletin 1964). (Societe Francaise pour l'Industrie de l'Aluminium, Marseille). June 1964. 106p.

The third bibliographic installment on Ga is presented. 723 references, predominantly of articles published since 1961, are compiled. There is an alphabetic list of authors and a compilation of patents. The bibliography is arranged in the categories generalities, geochemistry, preparation and purification with physics of the metal, physics of solid compounds, chemistry of the element and its compounds, analysis, biology, and uses. (J.S.R.)

41930 (NP-14294) MACROLAMINATE PARTICLE COMPOSITE MATERIAL DEVELOPMENT. Interim Report No. 2, June 1–August 1, 1964. F. H. Simpson and L. M. Stejskal (Boeing Co. Aero-Space Div., Seattle). Contract NOw 64-0194-f. 25p.

Methods of preparing laminate sheets to obtain controlled layer thicknesses were evaluated. Knife coating was selected as the method to be used for producing the laminate sheet for the macrolaminate particle geometry study. A study of the inter-relationship of temperature and pressure used for warm pressing has shown the types of flaws and fracture surfaces produced by the different combinations and that a pressure of 10,000 psi at 150°F is near optimum. The effect of atmosphere on sintering of the composite and the separate phases by themselves has shown vacuum to produce the greatest degree of ductility in molybdenum and that highest strength is achieved in composite specimens sintered in wet hydrogen. Vacuum sintering was selected for investigating the effects and inter-relationship of heating and cooling rates, time at maximum temperature, and maximum temperature. (auth)

41931 (SC-R-64-1331) MANGANESE GLASS FOR METALLIZING CERAMICS. R. M. Fulrath and E. L. Hollar (Sandia Corp., Albuquerque, N. Mex.). Sept. 1964. Contract AT(29-1)-789. 16p.

A bonding matrix of manganese-alumino-silicate glass has been used to bond metal molybdenum powder to alumina ceramics in preparation for brazing. Mechanisms of this bonding process were studied by use of optical and electron microscopy, electron microprobe, x-ray diffraction, and tensile tests. Variables studied, which affected the bond strength, included coating thickness, glass diffusion, glass-metal composition, metal particle size, and the relative thermal expansion of the ceramic, glass and metal. The study revealed remarkable similarity between glass-molybdenum metallizing and conventional molybdenum-manganese metallizing in both strength and physical appearance. (auth)

41932 (TID-7700(p.131-44)) CLASSIFICATION OF DERBIES BY DENSITY MEASUREMENTS. A. R. Diehl (National Lead Co. of Ohio, Cincinnati).

An effective method of ascertaining the degree of slag separation in uranium reguli (derbies) has been developed and tested. According to Archimedes' principle of bulk density, the derbies are weighed both wet and dry before and after shot blasting, and their densities are calculated. Measurements have been made in both pilot and actual plant environments. (auth)

41933 (TID-11295(3rd Ed.)) NUCLEAR FUELS AND MATERIALS DEVELOPMENT. William L. R. Rice, ed. (Division of Reactor Development, AEC). July 1964. 304p.

A summary is given of the work done in 1963 under the Advanced Reactor Technology Program of the Division of Reactor Development. Several U. S.-Euratom joint projects are also described. The materials and topics covered include fuel and fertile materials, cladding and structural materials, moderator materials, and materials testing. (D.L.C.)

41934 (TRG-Report-790) ELASTIC-PLASTIC DEFORMATION OF A LONG HOLLOW CYLINDER UNDER THERMAL CYCLING AND INTERNAL PRESSURE. J. Bree (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). June 3, 1964. 23p.

A fuel can, when subjected to sufficiently high thermal stresses and internal pressure, will yield plastically. The plastic strains so produced may cause the can to expand progressively as the temperature gradient across the can is cycled. Using an iterative procedure, a computer program is developed to determine the stress and strain distributions during each cycle and hence the incremental growth of the can per cycle. (auth)

41935 (UCRL-7387) SUPERPURIFICATION OF METALS BY VACUUM DISTILLATION: A THEORETICAL STUDY. R. F. Bunshah (California. Univ., Livermore. Lawrence Radiation Lab.). May 1964. Contract W-7405-eng-48. 22p.

The effect of process variables in the production of very-high-purity metals (i.e., impurity levels for metallics and gases at low ppm levels) has been explored. The most important variables for high purity are: 1. High evaporation rate, i.e., a high evaporation temperature. 2. Minimum contamination from vacuum environment, i.e., a good clean vacuum chamber and accessories. 3. Control over the condensation temperature. 4. A high-quality starting material, if necessary prepurified by vacuum melting. 5. Elimination of melt-crucible reactions. (auth)

41936 (UCRL-7919) HOLMIUM, A BIBLIOGRAPHY, 1955-APRIL 1964. Carl J. Wensrich (California. Univ., Livermore. Lawrence Radiation Lab.). Contract W-7405-eng-48. 37p.

A total of 176 references is presented on crystallographic and nuclear data, physical and chemical properties of holmium, holmium-165, and holmium ethyl sulfate. A subject index is included. (D.L.C.)

41937 (UJV-970/63) MĚŘENÍ VELIKOSTI ČÁSTIC A SPECIFICKÉHO POVRCHU PRÁŠKOVÝCH MATERIÁLŮ. (Measurement of the Size of the Particles and the Specific Surface of Powdered Materials). Hanuš Landsperský (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1963]. 64p.

A literature review is presented on the measurement of specific surface and size of particles including data on UO_2, referring to the relationship of the characteristics introduced above to the sinterability. Included are 166 references. Tables are included which show the particle size and specific surface of uranium oxides prepared from different starting materials such as UO_4, uranium oxalate, etc. as a function of the temperature of heating during and subsequent to reduction. Some of the data on specific surface area are also presented in graphical form in which the area is plotted against the temperature (or the reciprocal of the temperature) at which the material was prepared. This review is very thorough, covering all methods of measurement of surface area and particle size and in many cases giving the equations for calculation of the results. (TTT)

41938 (EURAEC-1058) FURTHER DEVELOPMENT OF THE ZIRCONIUM ALLOY $ZrNb_3Sn_1$ WITH A VIEW TO ITS USE AS CLADDING MATERIAL IN WATER-COOLED NUCLEAR REACTORS. Quarterly Report No. 2, January 1-March 31, 1964. H. Richter (Metallgesellschaft A.G., Frankfurt am Main). Apr. 20, 1964. Work Performed under United States-Euratom Joint Research and Development Program. Contract 019-63-11TEED. (E-2408). (A translation)

Comparative corrosion tests are being made to ascertain the influence of small admixtures of the elements chromium, iron, germanium, copper, antimony, tellurium, and vanadium on the corrosion behavior of $ZrNb_3Sn$. In 450°C steam the addition of iron resulted in the greatest corrosion reduction; additions of copper and antimony gave favorable results, provided that the tin content was reduced to 0.6-0%. In steam at 400°C the influence of the alloy additives is smaller; the best results were then obtained with samples containing iron and antimony, with tin contents between 0.3 and 0.6%. The lower limit of the alpha-beta transformation range still remains at 590°C when 0.1 to 0.2% antimony and vanadium are added. (auth)

41939 NUCLEAR FUELS AND FUEL ELEMENTS IN GERMANY. M. Becker, B. Liebmann, and G. Wirths (NUKEM, Nuklear-Chemie und -Metallurgie GmbH, Wolfgang, Ger.). Atomwirtschaft, 9: 404-7(Aug.-Sept. 1964). (In German)

The methods used in the Federal Republic of Germany for manufacture of fuel and breeder materials are described. Preparation of sintered UO_2, fuel rod manufacture, fuel element assembly, cladding metallic fuels, uses of depleted uranium, dispersions of U_3O_8 in polyethylene, manufacture of dispersions, preparation of elements, uses of thorium and plutonium in fuel elements, and development work for gas-cooled and fast-breeder reactors are discussed. (M.C.G.)

41940 PRODUCTION OF DENSE CRYSTAL OF UO_2 BY ELECTROLYSIS OF CHLORIDE MELTS AT 450-550°C. G. Chauvin and H. Coriou (CEN, Saclay, France). Metaux (Corrosion-Ind.), 39: 45-54(Feb. 1964). (In French)

The results obtained by a new method for the production of UO_2 crystals by electrolysis at a relatively low temperature (450 to 550°C) in the fused chlorides $LiCl-KCl-UO_2Cl_2$ are reported. The results were superior to those obtained with the usual procedure of high temperature electrolysis (800 to 900°C) in $NaCl-KCl-UO_2Cl_2$. The crystals obtained had the following characteristics: ratio $O/U = 2.00$ to 2.01, density = 10.70 to 10.90, and size = 0.4 to 3 mm (for 70% of the weight of each deposit). The other characteristics (cathode yield, carbon content, and spectrographic analysis) also appear satisfactory. Some points of this technique remain to be defined, as the conditions of washing and grinding. These crystals seemed to satisfy the fabrication conditions for fuel elements using vibration compacting method. (tr-auth)

41941 AN ELECTRODEPOSITION METHOD FOR THE PREPARATION OF ELECTRON MICROSCOPE SPECIMENS. W. Parker and H. Baumgartner (Reactor Center, Seiberdorf, Austria). Nature, 203: 715-16(Aug. 15, 1964).

An electrodeposition method is described for the preparation of samples for electron microscopy. The method was applied to a wide range of elemental compounds including U, Th, rare earths, Cs, Co, Fe, Zn, Sr, Ca, and Pu. (C.H.)

41942 RESEARCH AND DEVELOPMENT OF NUCLEAR GRAPHITE IN JAPAN. Takashi Mukaibo (Japan Atomic Energy Research Inst., Tokyo), Tatsuo Saito, Takeo Takeshima, and Yuji Ueda. Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 2: 319-21(1963).

The developments and actual performance, quality, and the manufacturing and machining techniques for nuclear graphite in Japan are discussed. It is now possible quantitatively and economically for the Japanese industry to meet any demand for nuclear graphite. The development of impervious graphite and glassy carbon is described. Graphite-CO_2 reaction under gamma radiation, diffusion of fission gases, dispersion type fuels, and government research on graphite are also discussed. (P.C.H.)

41943 REACTOR MATERIALS. Volume 7, Number 3. R. W. Dayton, E. M. Simons, and R. W. Endebrock (Battelle Memorial Inst., Columbus, Ohio). Fall 1964. \$0.70(GPO) (Domestic), \$0.90(GPO)(Foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC).

Properties, behavior, and fabrication processes of materials applicable to nuclear reactor components and associated equipment are reviewed. Separate abstracts are included for the five sections. (N.W.R.)

For abstracts of individual sections see: 41944, 41945, 41946, 41947, and 41987.

41944 FUEL AND FERTILE MATERIALS. Reactor Mater., 7: No. 3, 149-68(1964).

Research and development progress on uranium, uranium alloys, uranium dioxide, uranium carbides, uranium(IV-VI) oxides, uranium compounds, plutonium, plutonium alloys, plutonium compounds, plutonium dioxide, plutonium carbides, thorium, thorium alloys, thorium carbides, dispersion fuels, cermet fuels, coated-particle fuel materials, refractory fuels, coatings, radiation effects on fuel materials, corrosion mechanisms, and fertile materials is reviewed. (74 references). (N.W.R.)

41945 MODERATOR MATERIALS. Reactor Mater., 7: No. 3, 169-76(1964).

Research and development of graphite, beryllium metal and alloys, beryllium oxides, and zirconium hydrides for use as reactor moderators are reviewed. (25 references). (N.W.R.)

41946 NUCLEAR POISONS. Reactor Mater., 7: No. 3, 177-8(1964).

The development and testing of metallic and dispersion poison materials are reviewed. (12 references). (N.W.R.)

41947 CLADDING AND STRUCTURAL MATERIALS. Reactor Mater., 7: No. 3, 179-200(1964).

The development and properties of cladding and structural materials are reviewed. Information is included on: corrosion, metal-water reactions, radiation effects, mechanical properties, metallurgical properties, diffusion, ceramic technology, oxidation, and refractory technology. (101 references). (N.W.R.)

41948 PREPARATION OF NIOBIUM-BASE ALLOYS BY REDUCTION OF OXIDES USING CARBOTHERMAL METHOD. O. P. Kolchin, N. P. Chuveleva, and N. V. Sumarokova. Tsvtn. Metal., No. 7, 73-6(July 1964). (In Russian)

Preparation of Nb-base alloys by carbothermal reduction of oxides was studied using two types of reduction processes: (1) reduction of niobium pentoxide, alloy oxide, and Nb carbide; (2) reduction of Nb pentoxide and mixed niobium carbide-alloying metal. The reactions for both reductions are expressed by $Nb_2O_5 + 5NbC = 7Nb + 5CO$; (1) $Me_xO_y + yNbC = yNb - xMe + yCO$, (2) $5Me_xC + Nb_2O_5 = 2Nb - 5xMe + 5CO$, where Me is W, Mo, Zr, Ti, V, Ta, or Al. Combined reduction of Nb with W and Mo accelerated the reduction. Higher quality alloys with stable contents of O, N, and C were obtained at 2100°C. (R.V.J.)

41949 THE PENETRATION OF FIBROUS MEDIA BY AEROSOLS AS A FUNCTION OF PARTICLE SIZE. J. Dyment (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). 21p. (CONF-337-51).

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The accurate experimental determination of the penetration of fibrous filter media by aerosols as a function of particle size was investigated. A heterogeneous sodium chloride aerosol was sampled before and after passing through the glass fiber filter medium by means of an electrostatic precipitator and the samples were examined under the electron microscope; the relation between particle size and penetration was derived at different gas velocities by comparison of the size distribution of the filtered and unfiltered clouds. As an extension of this work, size analyses were made of plutonium aerosols occurring in glove boxes and enclosures during typical working operations; this information is considered in relation to the penetration of plutonium and other high density aerosol materials through filters. (auth)

41950 THE PARTICULATE MATERIAL FORMED DURING THE COMBUSTION OF POLONIUM AND PLUTONIUM. K. Stewart. 24p. (CONF-337-56)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The modes of formation of oxide aerosols from Po and Pu, which to a very considerable degree are representative of two important and contrasting processes, are discussed. Studies showed that polonium dioxide aerosols formed by combustion processes would consist of particles of a nature and size distribution determined by the process. In the complete absence of carrier nuclei the PoO_2 would be in the form of very dilute vapor together with nuclei consisting of a few tens of molecules. The nature of the radioactive particulate material released as a consequence of the combustion of Pu are very different from that produced by polonium. The particles are formed by the disintegration of the oxide layer that forms on the metal surface and in consequence a wide range of particle sizes are observed. (P.C.H.)

41951 TRANSACTIONS [OF] VACUUM METALLURGY CONFERENCE, 1963. Papers Presented During the Conference, June 17-18, 1963, New York. Rointan F. Bunshah, ed. Boston, American Vacuum Society, 1964. 361p. (CONF-40)

Twenty-one articles are included; a separate abstract was prepared for one. Three articles on cold hearth crucibleless vacuum induction melting, casting, and heating process, high temperature vaporization with the Bendix time of flight mass spectrometer, and stability of molten uranium and refractory carbides in high vacuum were previously abstracted in NSA as: 17: 30512, 32036, and 18: 580. The remaining 17 articles on various phases of vacuum metallurgy were determined not to be in scope for NSA. (P.C.H.)

For an abstract of the individual paper see: 41952.

41952 THE PLASMA ELECTRON BEAM SOURCE AND ITS APPLICATION TO VACUUM METALLURGY. M. A. Cocca and L. H. Stauffer (General Electric Co., Schenectady, N. Y.). p.203-20 of "Transactions [of] Vacuum Metallurgy Conference, 1963." Boston, American Vacuum Society, 1964.

The results of experiments conducted to better understand the physical properties and operational characteristics of cathode and also the results of preliminary experiments that utilized a plasma electron beam cathode in metallurgical applications in order to appraise its applicability to materials processing are described. The unique characteristics possessed by the plasma electron gun for use in vacuum metallurgy are listed. Melting results obtained with Nb and Mo buttons indicate that with a purified gas as a plasma medium, the plasma electron beam is capable of providing process purity conditions that are quite adequate for a variety of applications. The results of welding experiments on Rene 41 were found to be comparable to those obtained by other welding techniques. The data demonstrate that the perforated hollow cathode, when provided with an internal control grid, can generate well collimated and precisely controlled electron beams of high intensity. (P.C.H.)

41953 COATING APPARATUS. (to Commissariat à l'Energie Atomique). British Patent 970,094. Sept. 16, 1964. Priority date July 26, 1961, France.

An apparatus is designed for coating samples for metallographic examinations. The apparatus holds the sample firmly against a support while the coating material is being poured around the sample, thus keeping the bottom face of the sample free from coating material. An electrical pin can be attached to the coating (of resin) for a subsequent electrolytic polishing. The apparatus can be operated remotely for the coating of irradiated fissile materials. (D.L.C.)

41954 IMPROVEMENTS IN METHODS FOR THE PREPARATION OF POWDERS, NOTABLY ON URANIUM BASE. (to Commissariat a l'Energie Atomique). French Patent 1,284,062. Jan. 2, 1962. Filed Dec. 31, 1960.

Refractory powders, consisting of substantially spherical particles with a diameter of about 100 microns, were prepared by the disintegration of an appropriate cermet having a ceramic content of 60 to 90%. To prepare UC powder a U-UC cermet was prepared from U or UO_2 and C. The cermet was annealed at 1200 to 2200°C for 1 to 8 hrs to increase and uniformize the size of the UC particles, after which the cermet was disintegrated by hydrogenation at 200 to 300°C. The resulting mixture of UC and UH_3 powders was physically separated, e.g., by flotation, possibly after preliminary decomposition of the UH_3 by heating at 400°C. Similarly UN powder could be prepared by dissolution of a U-UN cermet in HCl, and U_3Si_2 powder by disintegration of the U-U_3Si_2 eutectic. In the latter case the annealing temperature is limited to 1000 to 1500°C. (NPO)

41955 POROUS CERAMIC HAVING VERY LOW THERMAL CONDUCTIVITY AND METHOD FOR ITS MANUFACTURE. (to Commissariat à l'Energie Atomique). French Patent 1,301,843. July 16, 1962. Filed June 12, 1961.

A porous ceramic material having a very low thermal conductivity was developed, which consists of a mass of grains of 5 to 20 μ dia between which are pores of the same size. The grains are constituted by micrograins of 0.01 to 0.02 μ dia with pores of the same size. The material is prepared by baking a compacted mass of micrograins at 1300°C, crushing the mass, mixing the powder with an equal volume of a filler (saccharose and nuclear graphite), molding the mixture, and sintering it at 1350 to 1400°C with elimination of the filler. The bodies can finally be coated with a refractory material. The ceramic, made from Al_2O_3, MgO, BeO, stabilized ZrO_2 or spinal (Al_2O_3 MgO), is intended for nuclear application. (NPO)

41956 CERAMIC-COATED FUEL PARTICLES. (to U. S. Atomic Energy Commission). French Patent 1,320,962. Feb. 4, 1963. Priority date Mar. 16, 1961, United States.

UO_2 particles (50 to 400 μ) were first coated with an inner porous Al_2O_3 layer and then with an outer dense layer of alpha-Al_2O_3 by hydrolyzing $AlCl_3$ in the presence of H_2 in a reaction chamber containing a fluidized bed of UO_2 particles first at 200 to 900°C to deposit the porous layer and then at 900 to 1400°C to deposit the dense layer. (NPO)

Corrosion

41957 (KAPL-3018) CORROSION AND HYDROGEN ABSORPTION CHARACTERISTICS OF Zr-2 at. % Sn-2 at. % Nb ALLOY IN HIGH-TEMPERATURE WATER AND STEAM. A. M. Andrako and C. Groot (Knolls Atomic Power Lab., Schenectady, N. Y.). July 24, 1964. Contract W-31-109-eng-52. 35p.

The corrosion of Zr−2 at. % Sn−2 at. % Nb alloy was measured in water and steam from 600 to 900°F, and from 1 to 350 days. The weight gain data may be represented by the following empirical equations: a. Pretransition $\ln W = 11.261 + 0.2780 \ln t - (9976/T)$, b. Posttransition $\ln \text{rate} = 21.2738 - (24129/T)$, where W = weight gain (mg/dm^2), t = time (days), T = absolute temperature (°Rankin), and Rate = corrosion rate ($mg/dm^2/day$). The activation energies were determined for both the cubic and linear corrosion periods and are 39.6 kcal/mole and 26.6 kcal/mole, respectively. The alloy is a less corrosion-resistant material than Zircaloy-2 when exposed in high-temperature water and steam. However, the oxide film formed is very adherent. Approximately 10% of the theoretical hydrogen generated during corrosion is then reabsorbed by the alloy. About 1% of the total weight gain is due to hydrogen pickup. These percentages remain about constant throughout the cubic and linear corrosion periods of the alloy; whereas, with Zircaloy-2, hydrogen absorption tends to increase after transition. (auth)

41958 (UJV-924/63) MĚŘENÍ KOROZNÍCH ÚBYTKŮ NEREZOVÝCH NEMAGNETICKÝCH OCELÍ A HLINÍKU PRILOŽENÍM ČIDLA. (The Measurement of Corrosion Loss on Non-Magnetic Stainless Steels and on Aluminum by the Application of a Sensing Device). Fr. Voženílek and P. Kovář (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1962]. 9p.

A description is given of a method for and the results of laboratory measurements of the corrosion loss on non-magnetic stainless steels and aluminum by the application of an eddy-current sensing device. For the measurement the Indicator IT-021-12 made in the reactor laboratory according to a technical document of the A. S. Papov Institute of Research for Communication Engineering was used. Shown are the observations made, the working up of the results, and the technical assumptions for the practical measurement in the primary technological circuit of the reactor. The experiences gained can be useful also for the workers who develop their own instrument. The sensing device IT-021-12 is based on the change of Q of an L-C circuit with the thickness of the metal to which the probe is applied. The sensitivity of measurement decreases as the thickness of the metal increases. The measurements given were on disks from 5 to 8 mm in thickness and showed errors of ±5 microns. (TTT)

41959 (WCAP-1844) THE GALVANIC BEHAVIOR OF MATERIALS IN REACTOR COOLANTS. D. G. Sammarone (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Aug. 1961. 68p.

Approximately 50 different couples between dissimilar materials used in nuclear steam generators designed by WAPD were evaluated for galvanic corrosion at temperatures ranging from 140 to 575°F in solutions of boric acid, boric acid and lithium hydroxide, lithium hydroxide, and in demineralized water with no additives. Couples other than those containing 2S aluminum, 4340 c/s, boronated stainless steel, boral, and nickel plated 80Ag–15In–5Cd with a 550°C heat treatment for 1 hour in vacuo were found to present no problems under the test conditions used. Cells containing either 2S aluminum or 4340 c/s were found to produce an excessive amount of galvanic corrosion at all but a few test conditions. The heat treatment used for nickel plated 80Ag–15In–5Cd control rod alloy significantly affected its resistance to galvanic corrosion. Galvanic corrosion results for cells containing boronated stainless steels and boral were inconclusive. Polarity reversals were found for two galvanic cells at high temperature. Since most cells were found to result in an insignificant amount of galvanic corrosion, effects due to temperature could not be detected. (auth)

41960 OXIDATION OF 90 Cb–10 Mo ALLOY IN THE TEMPERATURE RANGE 400 TO 1200°C. Thaddeus L. Kolski (E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). Am. Soc. Metals, Trans. Quart., 57: 690-700(Sept. 1964).

Reaction rates of 90 Nb–10 Mo alloy with oxygen at 1 atm were determined gravimetrically at temperatures between 400 and 1200°C (750 and 2190°F), for reaction times ranging from $6\frac{3}{4}$ to 200 hr. Temperature dependence of oxidation rate is highly irregular. Although oxidation was slow at 400°C (750°F), catastrophic oxidation rates occurred in the temperature region 450 to 550°C (840 to 1020°F), much like those observed for pure Nb. Catastrophic oxidation led to the formation of powdery, non-adherent outer scale growing from an irregular metal-oxide interface. A marked minimum in oxidation rate occurred near 600°C (1110°F). Above 600°C (1110°F) oxidation rate increased with increasing temperature to another maximum near 800°C (1470°F). A second minimum in reaction rate occurred near 900°C (1650°F), and higher temperatures led to oxidation rates that increased with increasing temperature up to 1200°C (2190°F). At temperatures of 600°C (1110°F) and higher, 90 Nb–10 Mo was much more oxidation-resistant than pure Nb. The outer scale formed on 90 Nb–10 Mo specimens oxidized at temperatures from 700 to 1200°C (1290 to 2190°F) was similar to the high temperature form of Nb_2O_5, on the basis of x-ray diffraction patterns. The scale formed at 600°C (1110°F) and lower temperatures was diffractometrically diffuse. Outer scale formed up to 500°C (930°F) was based upon the low temperature form of Nb_2O_5. Volatilization of MoO_3 from the scale was significant at 800°C (1470°F) and higher temperatures. (auth)

41961 USE OF CARBON-14 IN THE STUDY OF METAL–CARBON DIOXIDE REACTIONS. W. B. Jepson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Appl. Chem. (London), 14: 309-15(Aug. 1964).

When a metal is oxidized in carbon dioxide, the growth of oxide film may be accompanied by the deposition of carbon which may return to the gas phase as carbon monoxide, remain in the oxide film, or dissolve in the metal. Isotopic tracer techniques with ^{14}C provide a method by which the amount of carbon deposition may be measured and by which the fate of this carbon may be determined. The experimental techniques are outlined and numerical values are given, with illustrative results, for the oxidation of beryllium, a 20/25/niobium austenitic steel, and chromium. (auth)

41962 CORROSION OF STEELS AND NICKEL ALLOYS IN SUPERHEATED STEAM. W. E. Ruther and S. Greenberg (Argonne National Lab., Ill.). J. Electrochem. Soc., 111: 1116-21(Oct. 1964).

The corrosion behavior of the 18-8 stainless steels and some nickel alloys in superheated steam was found to be dependent on the surface preparation. The treatments that left a severely cold worked surface resulted in reduced corrosion attack in subsequent exposure to steam as compared with annealed metal surfaces. The corrosion rate of electropolished annealed type 304 stainless steel in oxygenated (30 ppm) steam rose rapidly as the temperature increased from 540° to 650°C. At 600 and 650°C the measured rate decreased with increasing time during 80 day static tests. The corrosion appeared more linear with time in dynamic tests at 650°C (~7 mg/dm^2-day). In these tests there appeared to be no effect of velocity (30–91 m/sec) or oxygen and hydrogen content on the corrosion rate. Flaking and loss of the outer corrosion coating was severe in the dynamic tests. The corrosion rate of type 406 was too small to be precisely measured in all of the tests, static and dynamic, in which it was simultaneously exposed with type 304. A coating equivalent to about 2×10^{-4} cm metal penetration was formed on the initial exposure of 406. No flaking of the outer coating was evident in 80 day tests. The corrosion attack of the 400 series steels in static oxygenated steam went down with increasing chromium content, particularly above about 13 wt.% Cr. Both type 430 (16 wt.% Cr) and 446 (25 wt.% Cr) exhibited greater short term corrosion resistance than type 304 to 650°C, 42 kg/cm^2 steam. The nickel based alloys, particularly Inconel 625, were also more corrosion resistant than type 304 in short static and dynamic tests in 650°C, 42 kg/cm^2, superheated steam. (auth)

41963 ANODIC OXIDATION OF TANTALUM IN FORMIC ACID ELECTROLYTES. D. M. Cheseldine (Sprague-TCC (Canada) Ltd., Toronto). J. Electrochem. Soc., 111: 1128-32(Oct. 1964).

Duplex films formed anodically on tantalum in formic acid and other organic electrolytes have both low capacity and low optical thickness per unit formation voltage. 1/c vs V curves show a break point, CV values being lower at higher voltages. The film adjacent to the metal has the characteristics of normal Ta_2O_5 and grows simultaneously with the outer more rapidly soluble film suggesting oxygen ion mobility in this outer film. Evidence from sequential formations in organic and aqueous electrolytes indicates also tantalum ion mobility and the growth of some new oxide in the pre-existing outer layer. Conditions at the electrolyte interface may exert some control on the number of oxygen ions entering the film. Other anions influence the film structure that is thought to contain voids. (auth)

41964 DIELECTRIC LOSS SPECTRA OF CORROSION FILMS ON ZIRCONIUM. P. J. Harrop and J. N. Wanklyn (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Electrochem. Soc., 111: 1133-6(Oct. 1964). (AERE-R-4472)

A technique was developed for examining the bulk electrical properties of dry zirconium dioxide films. It was used to determine the dielectric loss spectra of films formed by steam corrosion, and by anodization of Van Arkel zirconium. The most marked feature is a loss peak found for thermal films grown on pickled surfaces. This does not occur with anodized specimens or electropolished specimens and is postulated to be due to a fluorine-containing dipole. The dipole relaxes with an activation energy of 0.72 ± 0.04 ev. An interpretation of the data suggests a lower limit of concentration of 1×10^{20} fluorine ions per cubic centimeter in films of about 1500Å thickness. Anodic films show low loss curves consistent with near-stoichiometric structure. (auth)

41965 SOME OBSERVATIONS ON THE HIGH-TEMPERATURE OXIDATION OF LANTHANUM. W. L. Phillips (E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). J. Electrochem. Soc., 111: 1184-5(Oct. 1964).

Weight gains studies were made on the oxidation of La at high-temperatures. The results demonstrated that La oxidizes linearly in the temperature range of 600 to 850°C. X-ray data and observations indicate that La oxidizes completely to lanthanum oxide by either a continuous or discontinuous mechanism. (P.C.H.)

41966 CORROSION PHENOMENA IN CERTAIN TYPES OF NUCLEAR REACTORS. Milan Zaric ("Boris Kidrich" Inst. of Nuclear Sciences, Belgrade). Tehnika (Belgrade), 18: 2008-12(1963). (In Serbo-Croatian)

In low-temperature water cooled reactors, up to 100°C, the corrosion of aluminum was considered under possible exploitation conditions, i.e., the given temperature, and high purity ordinary or heavy water. It is emphasized that corrosion of aluminum in water, including the formation of a protecting film, depends on the temperature and the purity of water, and it arises through anodic and cathodic reactions, which are presented. (P.C.H.)

41967 CORROSION LOOP TEST RIG (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-918)

Six drawings of components of a corrosion loop are included. The thermocouple patch (an aluminum panel) accommodates 24 incoming thermocouples. The heater power supply has an input of 115 v, 60 ohm, and 5 amp with an output of 0 to 135 v and 5 amp. The temperature control unit uses mercury relays and a Brown recorder. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

41968 NICKEL ALLOY. (to U. S. Atomic Energy Commission). French Patent 1,229,765. Mar. 28, 1960. Priority date Mar. 3, 1958, United States.

Ni-Mo-C alloys were prepared, which are resistant to oxidation and to corrosion by fused salts and can thus be utilized as a structural material for certain types of nuclear reactors. A preferred composition is 12 to 20% Mo, 0.2 to 0.5% C, 0 to 8% Cr, 0 to 4% W, Ta, V, or Nb, and the balance Ni. (NPO)

41969 ZIRCONIUM ALLOYS. (to United Kingdom Atomic Energy Authority). French Patent 1,244,537. Sept. 19, 1960. Priority date Oct. 21, 1958, Great Britain.

Zirconium alloys with a good corrosion resistance toward water and steam were prepared of 0.125 to 0.5 at.% Cr, 0.5 to 2.0 at.% Sn, and the balance Zr. These alloys could be prepared by arc fusion in vacuum, followed by homogenization and rolling. (NPO)

41970 ZIRCONIUM ALLOY. (to Metallgesellschaft AG). French Patent 1,249,151. Nov. 14, 1960. Priority date Mar. 4, 1959, Germany.

Zirconium alloys with an improved corrosion resistance and a very low neutron absorption were prepared containing 0.05 to 1.5%, preferably 0.1 to 0.8, Pd. (NPO)

41971 ALLOYS FOR UTILIZATION AT HIGH TEMPERATURES IN A CARBON DIOXIDE ATMOSPHERE. (to Associated Electrical Industries Ltd.). French Patent 1,307,236. Sept. 10, 1962. Priority date Dec. 2, 1960, Great Britain.

Be alloys, which are corrosion resistant toward hot and humid CO_2 and steam, were prepared of 0.05 to 3 wt %, preferably 0.5 wt %, Ca and the balance Be. They can be utilized as canning material in CO_2-cooled reactors. (NPO)

41972 METHOD OF TREATING ZIRCONIUM ALLOYS. (to Communaute Europeenne de l'Energie Atomique (EURATOM)). French Patent 1,307,550. Sept. 17, 1962. Priority date Mar. 23, 1961, Germany.

Zr alloys containing 0.5 to 5% Nb, up to 3% Sn, and up to 0.5% Fe, Ni, Cr, Ta, Pd, Mo, and W, the total content of the last-named metals not surpassing 2%, are described. Their corrosion resistance toward pressurized water and steam was improved by cold shaping the alloys and giving them a final heat treatment at 550 to 590°C. (NPO)

41973 METHOD OF INHIBITING METAL CORROSION BY HIGH TEMPERATURE STEAM. (to United Kingdom Atomic Energy Authority). French Patent 1,309,533. Oct. 8, [1964]. Priority date Dec. 9, [1961], Great Britain.

The corrosion of metals (Be, Al, or Zr alloys) by high-temperature dry steam under pressure was inhibited by incorporating 0.3 wt % boric acid in the steam, the B being essentially ^{11}B. This method was applied in steam-cooled nuclear reactors. (NPO)

Fabrication

41974 (AAEC/TM-255) THE DEVELOPMENT OF HIGH-DENSITY, FINE-GRAIN-SIZE, HIGH-STRENGTH BERYLLIUM OXIDE BY ISOSTATIC PRESSING. K. D. Reeve and K. C. Bridgford (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). June 1964. 13p.

The effects of sintering temperature on the sintered density and grain size of isostatically pressed Brush UOX BeO powder, isostatically pressed both as-received and after ball milling, and then sintered for 1 hour in dry nitrogen, have been determined and presented graphically. The grain size/density relationship for as-received powder is shown to fit an established pattern, but ball-milled powder behaves differently, giving much larger grain sizes than as-received powder at the same densities. This difference is attributed to the higher impurity level in the ball-milled material. As-received powder sintered at 1525°C for 1 hour gave a strong, dense, fine-grained material. Ball-milled powder could be sintered to high densities, but, compared with as-received powder, grain sizes were higher and strength values lower. (auth)

41975 (BRB-83) SUMMARY OF THE DYNAPAK EXTRUSION OF URANIUM TUBES. Q. C. Carloni and L. Robins (Reactive Metals, Inc., Seymour, Conn.). Sept. 11, 1964. Contract AT(30-1)-1405. 30p.

The status of the program performed at the Bridgeport Brass Company to develop the high energy rate extrusion process for uranium tubes is summarized. The Model 1800 horizontal DYNAPAK machine was employed. A description of a possible DYNAPAK extrusion production plant and rough estimates of the installation and operational costs are presented. The DYNAPAK fabrication route shows the potential to become economically competitive with the conventional extrusion route now employed in tube production. This assumes that late-model equipment, such as the model 1220 DYNAPAK machine, is employed. DYNAPAK extrusion has been successfully employed to produce single-slug length tubes of the (a) Mark VB-O and (b) I&E sizes, relatively thin and thick walled tube types, respectively. Double-slug length I&E tubes were produced in quantity under production test conditions, however, there was a warpage problem. The model 1800 machine did not possess sufficient energy to fully extrude the double-slug length Mark VB-O tube. (auth)

41976 (EUR-1818-i) SALDATURA E FORMATURA DEL SAP CON EXPLOSIVI. (SAP Welding and Forming by Means of Explosives). H. Holtbecker and M. Montagnani (Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Delft and European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 20p. (CONF-425-3)

From Conference on Nonfissile Metals for Nuclear Reactors, Bologna, Dec. 1963.

A joint is to be fitted in the ORGEL reactor between the steel primary circuit and the SAP channel. The rolled joints are not entirely leaktight and a weld must be found which ensures leaktightness. Furthermore, in order to make possible some special channel designs the SAP has to be formed in order to reduce the diameter over a certain length. Shock waves were utilized in an attempt to solve these problems. 1. Welding. Preliminary welding tests were carried out on strips of the following materials: aluminum–aluminum, aluminum–stainless steel, SAP–aluminum, SAP-SAP, and SAP-stainless steel. The need for a bonding between SAP and steel in order to reduce the brittleness of the intermetallic layer was recognized. Welding tests on tubes have been commenced. 2. Forming. The possibility of obtaining, by means of an explosion, a reduction in diameter in a section of SAP 10% oxide tube ~90 mm in diameter was studied. Preliminary experiments showed the importance of the shape of the explosive charge and the need for a vacuum between tube and mandrel in order to avoid collision and ripples. Diameter reductions of between 5 and 20%, were obtained. Some of the characteristics of the formed zones were checked. (auth)

41977 (EUR-1844.f) CONTRIBUTION A L'ETUDE DES POSSIBILITIES DE FABRICATION DE PRODUITS EN ALUMINUM FRITTE. (Possibilities of Preparation of Dispersion-Strengthened Aluminum). E. G. Hess (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 31p. (CONF-704-1)

From Proceedings of Fall Metallurgy, Paris, Oct. 1963.

Some aspects regarding extrusion and several methods of cold-work of dispersion-strengthened aluminum (SAP) containing 4 to 14% Al_2O_3 have been investigated. Extrudibility, extrusion constants, and the general hot-work behavior are described. Subsequent cold-work carried out by rolling, drawing, tube-reducing, and swaging gives a survey on some plastical attitudes. The maximum deformability—limited by the resistance to recrystallization—and both the influence of cold work on the dispersion structure and the mechanical properties are examined. With increasing cold-work, three ranges with different deformation mechanisms can be observed: (1) Work hardening of the matrix. (2) Refinement of the banded structure originating from the extrusion. (3) Considerable dispersion improvement by cracking and distribution of oxide agglomerates and intermetallic compounds like $FeAl_3$ in the range of the highest reductions. (auth)

41978 (NP-14348) MANUFACTURE OF URANIUM–8.5% MOLYBDENUM BALLS. R. V. London and R. E. Edelman (Frankford Arsenal, Philadelphia). July 1964. 17p. (M65-3-1)

In an effort to meet increasing demands for components fabricated from dense materials (such as an 0.20 in. diameter ball weighing 20 ± 1 gr), a study was made to find suitable material and methods of processing. Of the two materials (uranium- and tungsten-based alloys) having the necessary density, an uranium–8.5% molybdenum alloy was chosen because of its combination of strength and ductility. The problem of fabricating a smooth wire, free from kinks and surface imperfections was undertaken, and the various phases of processing—casting, heat treating, forging, rolling, annealing, swaging, and testing—are described. A feasibility study to determine techniques for manufacturing production quantities of uranium balls was undertaken, using the cold heading technique and then grinding the rough balls to size, using standard production equipment. The methods of pressing the material, rill filing, and tumbling are described. (auth)

41979 (ORNL-TM-929) WELDABILITY EVALUATION OF THE NIOBIUM ALLOY C-129Y. R. G. Donnelly (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 20p.

A study was conducted to investigate the general weldability of an advanced niobium alloy, C-129Y. This second-generation alloy has the composition Nb–10% W–10% Hf–0.1% Y and is reported to have enhanced weldability over the yttrium-free composition. Gas tungsten-arc welds in an inert atmosphere chamber and electron-beam welds were made and evaluated. Both unwelded material and electron-beam welds were found to be ductile in bend tests down to –195°C(–320°F). Manual and automatic gas tungsten-arc welds were fully ductile at –73°C(–100°F) but cracked upon bending at –195°C(–320°F). The automatic welds averaged 60° of bending at this temperature while the manual welds bent only 20° before cracking. All three types of welds could be bent around a 1T bend radius (T = sheet thickness) at room temperature without cracking. An aging phenomenon resulting in embrittlement was detected in welded samples at 815 and 980°C(1500 and 1800°F) and the time-temperature parameters were outlined. A post-weld heat treatment of 1 hr at 1093°C(2000°F) was found to be an effective overaging treatment to reduce the embrittling tendencies. (auth)

41980 (PAN-496/XIV) Mn 80–Ni 20 SINTERED LEAF. W. Rutkowski and W. Szteke (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Feb. 1964. 10p.

Using the powder metallurgy technique, a sintered Mn 80 Ni 20 leaf has been prepared. Diffusion heating of the powder mixture, as well as cold pressing under a load of 8 ton/cm^2, and sintering in argon saturated with methanol at 1000°C temperature were used. The sinter was then polished to 0.13 mm thickness. High chemical purity was achieved. The leaves were designed for neutron current measurements in nuclear reactors. (auth)

41981 (AEC-tr-6478) POROUS MEMBRANE OF ALUMINA AND PROCEDURE FOR THE FABRICATION OF THESE MEMBRANES. Roger Rigot and Pierre Plurien. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn., from French Patent 1,174,795, Mar. 16, 1959. 6p.

An invention is described that has as its object a claim of a new industrial product. Porous membranes of corrosion-resistant alumina were produced with very fine and very numerous pores. The manufacturing procedure for these membranes is by oxidation of a sheet of Al with the object of obtaining gaseous diffusion barriers highly resistant to chemical corrosion. The procedure of fabrication of these membranes is essentially characterized as one in which a sheet of Al of regular thickness without any unexpected holes, or defects, is transformed into a honeycomb-type grill in which the thinner areas are not open and in which the thin portions are eventually transformed into porous alumina by oxidation, producing a film of the oxide fixed solidly on a metallic grill. (auth)

41982 A REFRACTORY METAL ALLOY HOT PRESSED FROM ELEMENTAL POWDERS. J. E. White (Aerospace Corp., Los Angeles). Am. Soc. Metals, Trans. Quart., 57: 756-9(Sept. 1964).

Tungsten base alloys containing Mo, Nb, and/or Ta were consolidated directly from elemental powders by hot pressing and annealing. An alloy with a nominal composition of 80 W–10 Mo–10 Nb was consolidated from 1-μ W and Mo powders along with 10- to 40-μ Nb. The powders were dry blended and hot pressed in graphite dies at 2100°C and 6000 psi for 30 min. The results suggest that after a sound interparticle bond is established by hot pressing, diffusion of the refractory metal alloying elements is sufficient at temperatures above 2000°C to make feasible a homogeneous product from solid-state consolidation. This is shown by the electron probe results of the hot-pressed condition where at no point did the Mo or Nb concentration approach zero. (P.C.H.)

41983 EFFECTS OF VACUUM SINTERING ATMOSPHERE ON THE PROPERTIES OF SINTERED UO_2 PELLETS. I. Kawasaki, et al. Funtai Oyobi Funmatsuyakin, 10: 248-56(Dec. 1963). (In Japanese)

Changes in the properties of UO_2 compacts such as density, porosity, weight, O/U ratio, and average grain size, with increasing sintering temperature were determined for three different kinds of UO_2 powder with various sintering atmospheres. Hydrogen, vacuum, and several combinations of these were compared. Conditions of compacting, sintering time, and both heating and cooling rates were constant throughout the experiment. (UKAEA)

41984 FABRICATION OF TARGETS FOR NEUTRON IRRADIATION OF NEPTUNIUM DIOXIDE. R. E. Myrick and R. L. Folger (E. I. du Pont de Nemours & Co., Aiken, S. C.). Ind. Eng. Chem., Process Design Develop., 3: 309-13(Oct. 1964). (DPSPU-63-30-43)

Neptunium targets for neutron irradiation in a nuclear reactor were fabricated by a powder metallurgy process. Blends of neptunium dioxide and aluminum were compacted at ambient temperature to about 90% of theoretical density, and the compacts were jacketed by sintering in an aluminum can at 550° to 625°C under 19 tons per square inch. Metallurgical bonding of the core and cladding occurred primarily by grain growth across the core-cladding interface. Process parameters were explored with neptunium dioxide and also with thorium dioxide and uranium dioxide as metallurgical substitutes. Bond strength generally increased with sintering temperature and varied inversely with actinide concentration in the core. Solid state reduction of each actinide oxide by aluminum to form aluminides was also observed. The strengths of core-cladding bonds across $ThAl_3$ and across $NpAl_4$ were also measured. (auth)

41985 PLANNING A PLUTONIUM FACTORY. S. E. Smith (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). New Scientist, 23: 554-6(Sept. 3, 1964).

The design of a proposed plutonium facility is presented. Essentially there are three main sections to the plant that has been conceived. The first will manufacture the fuel itself, in powder form. The second will convert the powder into a compact, such as pellets. And the third section will fabricate the fuel element pins and assemble them into clusters ready for the reactor. The operation in each section is discussed. (P.C.H.)

41986 A SIMPLE ELECTRON BOMBARDMENT EVAPORATOR FOR HIGH MELTING POINT MATERIALS. Y. Dar (Weizmann Inst. of Science, Rehovoth, Israel), H. M. Loebenstein, and J. De Boer. Nucl Instr. Methods, 27: 327-8(July 1964).

An evaporator, which uses a focused electron beam impinging on a small carbon crucible as a heat source, is described. The device was found practical for the preparation of targets of rare earth oxides and high-melting-point metals. (auth)

41987 SPECIAL FABRICATION TECHNIQUES. Reactor Mater., 7: No. 3, 201-9(1964).

Research and development progress on melting, hot and cold working, cladding procedures, welding and brazing, and nondestructive testing is reviewed. (59 references). (N.W.R.)

41988 IMPROVEMENTS RELATING TO THE MANUFACTURE OF CERMET NUCLEAR FUELS AND FUEL ELEMENTS CONTAINING SUCH FUELS. Lawrence Henry Cope and Richard John Warmer (to United Kingdom Atomic Energy Authority). British Patent 969,975. Sept. 16, 1964. Filed Mar. 27, 1962.

A method for manufacturing a cermet fuel body is given which results in cermet densities of ~97% of theoretical density. In the method, a sintered compact of the cermet is subjected to repeated coining operations, the compact being annealed between consecutive coining operations. The coining is preferably carried out at least three times at pressures increasing in the range 50 to 100 tsi. An example of the method is described in which dispersions of UO_2 in stainless steel were produced. (D.L.C.)

41989 IMPROVEMENT IN NUCLEAR FUEL RODS. (to Societe Indatom). French Patent 1,224,231. Feb. 8, 1961. Filed Jan. 27, 1959.

Fuel rods were developed which consist of a column of ceramic fuel pellets (UO_2 and/or PuO_2) in a jacket. To improve transversal heat transport the contacting end faces of the pellets were coated with a heat-conducting layer, consisting of Al, Mg, or Be or their oxides. (NPO)

41990 NUCLEAR FUEL SLUG CONTAINING AN ACTINIDE MONOCARBIDE. (to Union Carbide Corp.). French Patent 1,233,911. May 9, 1960. Priority date Aug. 27, 1958, United States.

Fuel slugs, consisting of a dispersion of up to 70 wt % UC, PuC, or ThC in graphite were prepared by compressing a mixture of an actinide compound (oxide, halogenide, or carbide), graphite, and a binder and firing the compacts at 1600 to 2000°C. Various embodiments are described. (NPO)

41991 METHOD OF PRODUCING URANIUM OXIDE BODIES. (to United Kingdom Atomic Energy Authority). French Patent 1,267,989. June 19, 1961. Priority date June 22, 1959, Great Britain.

Uranium dioxide with an O:U ratio inferior to 2.3 and at least 1 wt % of an organic polymeric binder, such as polybutyl methacrylate plastified with dibutyl phthalate, was compressed at 3140 to 4710 kg/cm^2. The compacts were heated in air to 245 to 250°C at a velocity that did not surpass 17°C/hr and held at that temperature for 14 hr; the oxide was thereby rendered nonstoichiometric. Finally, the compacts were sintered either in Ar or N_2 at 1300 to 1500°C, in Ar or N_2 at 1300 to 1500°C and followed by a reduction in H_2 above 1000°C, or in H_2 at 1500 to 1700°C. Sintering in Ar or N_2 at 1300 to 1500°C gave a nonstoichiometric product while the other two conditions gave a stoichiometric product. (NPO)

41992 IMPROVEMENTS IN METHODS FOR THE FABRICATION OF GRAPHITE. (to C. A. Parsons and Co. Ltd.). French Patent 1,275,922. Oct. 2, 1961. Priority date Dec. 14, 1959, Great Britain.

Fabrication of nuclear graphite from petroleum coke is described. In order to increase the density of the graphite, granular coke was treated in a fluidized bed with a fluid, that through thermal decomposition can deposit carbon in the pores of the granules, after which the granules are subjected to an eroding process, in a cyclone, in which they are rounded off. (NPO)

41993 METHOD OF MANUFACTURING ROUND CYLINDRICAL ELEMENTS, ESSENTIALLY COMPOSED OF ZIRCONIUM OR NIOBIUM. (to Mitsubishi Atomic Power Industries, Inc. and Mitsubishi Denhi Kabushiki-Kaisha). French Patent 1,289,146. Feb. 19, 1962. Priority date May 11, 1960, Japan.

Zirconium and Nb rods and tubes, for use as sheaths for cylindrical fuel elements, were manufactured by rotary swaging. For manufacturing a tube the annular space between a stainless steel outer tube and a copper inner tube was filled with Zr or Nb powder and the annular space closed at both ends. A zinc mandrel was inserted in the inner tube and the assembly subjected to rotary swaging at ambient temperature, with the last pass effected at elevated temperature. Finally the mandrel was removed by melting, the Cu tube by dissolution, and the stainless steel tube by cutting. (NPO)

41994 FRITTED BERYLLIUM BODIES AND THEIR METHOD OF MANUFACTURE. (to United Kingdom Atomic Energy Authority). French Patent 1,289,662. Feb. 26, 1962. Priority date Mar. 4, 1960, Great Britain.

The sinterability of nuclear-grade, electrolytic Be powder was materially improved if the Al and Si content of the Be was chosen between 500 and 2000 ppm. Compacting the adjusted powder at 17.5 kg/cm^2 and 1050 to 1100°C in a vacuum of 50 microns gave bodies with a density of over 90% of the theoretical value. (NPO)

41995 FUEL ELEMENTS FOR NUCLEAR REACTOR AND THEIR METHOD OF MANUFACTURE. (to Deutsche Gold- und Silber-Scheideanstalt). French Patent 1,290,178. Mar. 5, 1962. Priority date Feb. 20, 1960, Germany.

Spherical fuel elements were prepared by inserting a quantity of nuclear fuel (UC_2, UC, UO_2 + C, UF_4, etc.) in the central cavity of a graphite pebble, obturating the cavity with a graphite plug and heating the pebble above the melting point of the fuel, which causes the fuel to penetrate into the pores of the graphite. Finally the outer zone of the pebble is impermeabilized by deposition of finely divided C or by some other means. (NPO)

41996 METHOD OF PREPARING SINTERED URANIUM DIOXIDE. (to United Kingdom Atomic Energy Authority). French Patent 1,290,492. Mar. 5, 1962. Priority date Apr. 29, 1960, Great Britain.

Compacts of UO_2 or UO_2-PuO_2 powder were sintered in CO_2 or CO_2 + CO at 1300 to 1600°C, the CO content of the atmosphere depending on the $UO_2:PuO_2$ ratio. Thus with 10% PuO_2 the $CO:CO_2$ ratio was 1:100 to 1:10, with 30% PuO_2 it was 1:20 to 1:1. The stoichiometric sintered bodies were cooled in wet H_2 or in a 1:10 to 100:1 mixture of CO and CO_2. (NPO)

41997 METALLURGICAL PROCESS FOR BONDING ZIRCONIUM TO A FERROUS METAL. (to Nuclear Metals, Inc.). French Patent 1,291,805. Mar. 19, 1962. Priority date May 25, 1960, United States.

A method for metallurgically bonding Zr to stainless steel by hot coextrusion of contiguous parts in a malleable iron jacket is described. (NPO)

41998 METHOD OF MANUFACTURING JACKETED FUEL ELEMENTS FOR ATOMIC PILES. (to Atomenergikommissionen). French Patent 1,293,406. Apr. 2, 1962. Priority date June 28, 1960, Denmark.

To manufacture a fuel element a jacket that was capped at its bottom was alternately filled with fuel pellets and disks of a low melting, heat-conductive metal (e.g., NaK, Pb, Sn, Sb, or Bi). A mechanical pressure was applied to the pellet column by means of a spring; the jacket was evacuated and led through a heated region while it was vibrated. This caused the disks to melt and to fill the interstices between the pellets and the jacket while occluded air was eliminated. (NPO)

41999 IMPROVEMENTS IN METHODS AND APPARATUS FOR HEAT FORGING, NOTABLY FOR THE FORMATION OF A CONSTRICTING GROOVE. (to Commissariat a l'Energie Atomique). French Patent 1,298,452. June 4, 1962. Filed May 31, 1961.

An induction-heated apparatus for mechanically fastening an end plug in a fuel element sheath by means of a constricting groove is described. (NPO)

42000 METHOD OF SINTERING METAL OXIDE POWDERS SUCH AS URANIUM DIOXIDE. (to Commissariat a l'Energie Atomique). French Patent 1,300,794. July 2, 1962. Filed June 2, 1961.

UO_2 powder having a specific surface area of at least 4 m^2/g was compacted to 45% of the theoretical density. The compacts were then rapidly heated to and sintered at 1400 to 1800°C, the total heating time not surpassing 3 hr. (NPO)

42001 METHOD OF JACKETING FUEL ELEMENTS, THE JACKET OF WHICH IS MORE DILATABLE THAN THE FUEL. (to Commissariat a l'Energie Atomique). French Patent 1,303,045. July 30, 1962. Filed July 24, 1961.

A canning method by which the jacket is hydrostatically pressed into grooves in the fuel is described. Where the jacket is more dilatable than the fuel, notably in canning U with Mg, it is proposed that the pressing be carried out in two steps, the first at ambient temperature, the second at the supposed operating temperature of the fuel element in the reactor. (NPO)

42002 METHOD OF WORKING BERYLLIUM. (to United Kingdom Atomic Energy Authority). French Patent 1,303,258. July 30, 1962. Priority date Oct. 4, 1960, Great Britain.

A beryllium ingot with a grain size of 80 to 300 μ was hot rolled at 200 to 500°C to give the body a fibrous grain structure and then annealed at 850 to 1000°C from 15 to 300 sec so that the final grain size was not larger than 80 μ. (NPO)

42003 IMPROVEMENTS IN METHODS OF SINTERING CARBIDES SUCH AS URANIUM AND PLUTONIUM CARBIDES. (to Commissariat a l'Energie Atomique). French Patent 1,303,488. Aug. 6, 1962. Filed June 19, 1961.

PuC and/or UC powder, prepared from the oxides or hydrides by reaction with C and having a grain size of 35 microns, was mixed with 0.2 to 1% ferrous metal, preferably Ni, and 1 to 2% binder (naphthalene or paraffin), then cold pressed at 3 to 5 t/cm^2 and sintered at 1400 to 1500°C. The sintered bodies had 93 to 98% of the theoretical density. (NPO)

42004 METHOD OF OBTAINING A STRONG BOND BETWEEN URANIUM AND ALUMINIUM, AND PRODUCTS THUS OBTAINED. (to Atomic Energy of Canada Ltd.). French Patent 1,317,848. Jan. 2, 1963. Priority date Mar. 28, 1961, United States.

A strong bond between U and Al was obtained by first depositing a thin layer of uranium oxide on the U, preferably by anodic oxidation in an 8 to 25% NaOH solution at 15 to 30 v for 3 min, and then hot extruding Al on to the U. The oxide layer acts as a diffusion barrier. (NPO)

42005 IMPROVEMENTS IN METHODS OF CANNING NUCLEAR FUEL. (to Compagnie Francaise Thomson-Houston). French Patent 1,317,994. Jan. 7, 1963. Filed Jan. 5, 1962.

Pyrolytic graphite sheaths of fuel elements were closed at their extremities by insertion of a pyrolytic graphite plug, the crystal orientation of which was parallel to that of the sheath, and heating the assembly in a hydrocarbon atmosphere. (NPO)

42006 GRAPHITE COATING OF NUCLEAR FUEL PARTICLES. (to High Temperature Materials, Inc.). French Patent 1,321,771. Feb. 11, 1963. Priority date May 1, 1961, United States.

Fuel particles (UO_2, UC, UC_2) were coated with pyrolytic graphite by putting the particles in contact with CH_4, C_2H_6, C_3H_8, or C_6H_6 at 1700 to 3000°C, preferably 2050 to 2250°C, and 1 to 200 mm Hg, preferably 2 to 21 mm Hg. The coating process was carried out in an induction-heated rotating graphite furnace. It was concluded that pyrolytic graphite coatings have a higher resistance, density, and impermeability than amorphous pyrolytic carbon coatings. (NPO)

42007 IMPROVEMENTS IN THE PREPARATION OF SINTERED PLUTONIUM DIOXIDE. (to United Kingdom Atomic Energy Authority). French Patent 1,322,494. Feb. 18, 1963. Priority date Apr. 27, 1961, Great Britain.

High-density PuO_2 sintered bodies were prepared by adding to the compressed powder 0.05 to 2 wt % Fe as $Fe(NO_3)_3$ and sintering in air at 1400 to 1650°C. (NPO)

42008 METHOD OF PREPARING URANIUM OXIDE BRIQUETTES. (to U. S. Atomic Energy Commission). French Patent 1,323,900. Mar. 4, 1963. Priority date May 19, 1961, United States.

A method of preparing UO_2 compacts with an improved solidity and density is described. Easily sinterable UO_2 powder (specific surface 6 to 8 m^2/g, particle size less than 40 microns, apparent density 1.5 to 2.5 g/cm^3, and $O:U = 2.08$ to $2.13:1$) was mixed with 2 to 5 wt % H_2O. The mixture was precompacted at 175 kg/cm^2 and again ground to obtain a fluid powder of 100 to 500 microns grain size. This powder was compacted at 700 to 1050 kg/cm^2 and sintered in a reducing atmosphere. (NPO)

42009 METHOD OF PRODUCING SPHERICAL PARTICLES. (to United Kingdom Atomic Energy Authority). French Patent 1,325,329. Mar. 18, 1963. Priority date June 12, 1961, Great Britain.

A method and apparatus for producing spherical KO_2 particles are described. Granular KO_2 is placed in a circular or annular disk with an abrasive internal surface and the disk is vibrated and oscillated. (NPO)

Properties and Structure

Refer also to abstracts 41477, 42314, 42422, 42443, 42889, and 42970.

42010 (ASD-TR-61-203(Pt.III)) THE MECHANICAL PROPERTIES OF TANTALUM WITH SPECIAL REFERENCE TO THE DUCTILE-BRITTLE TRANSITION. G. Abowitz and R. A. Burn (Materials Research Corp., Orangeburg, N. Y.). Mar. 1963. Contract AF33(616)-7173. 57p. (AD-424683)

The tensile behavior of dilute Ta−H and Ta−Mo alloys was studied as a function of alloying addition, grain size, and test temperature at a constant strain rate of 10^{-3} sec^{-1}. The results are interpreted in terms of the parameters σ_i and k_y of the Petch equation. For Ta−H alloys at 25°C, σ_i was independent of hydrogen content whereas k_y increased with hydrogen content. Deformation twinning was not observed in Ta–H alloys either at 25°C or at −196°C. Dilute additions of Mo to Ta at 25°C resulted in an increase in k_y whereas σ_i was unaffected. Twinning was observed at −196°C but not at 25°C. A large increase in ductility accompanied twinning. (auth)

42011 (ATL-A-141) INVESTIGATION OF THERMAL-STRESS-FATIGUE BEHAVIOR OF STAINLESS STEELS. SUMMARY OF TEST RESULTS ON TYPES 304 AND 304-L STAINLESS STEELS. K. E. Horton (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Apr. 10, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-250. 129p. (EURAEC-1034)

In an effort to fatigue-test nuclear reactor materials under conditions similar to those that would be expected in actual practice, a thermal-stress-fatigue program was conducted in which stress cycling was induced by thermally cycling a constrained specimen. A major departure from conventional data-presentation methods was made by plotting logarithmic plastic-strain range versus logarithmic cycles to failure. It was hoped, and largely proved, that such curves would be more "independent" of test conditions than curves of stress versus cycles to failure. The major reason why data have not been presented in this new way in conventional fatigue programs is the extreme difficulty in measuring small plastic strains. A summary is presented of the results of thermal-stress-fatigue testing on Types 304 and 304-L austenitic stainless steels, and the effects of metallurgical variables (e.g., grain size, degree of cold work) and external variables (e.g., mean temperature, test time, surrounding atmosphere, specimen size) on fatigue resistance are discussed. The large number of variables studied showed that a band of data points would satisfactorily represent fatigue resistance and that gross changes in test conditions, such as holding temperature constant and cycling load instead, did not change the position of the data band. However, a close examination of test results revealed that certain specimen and test conditions cause a relative increase in fatigue resistance within the data band. In contrast to other thermal-stress-data presentations, many graphs shown clearly exhibit two distinct failure curves—one for pure-fatigue failure (no specimen distortion) and one for instability failure (with specimen distortion). (D.L.C.)

42012 (AWRE-O-66/64) RESISTANCE TO DEFORMATION OF SOME URANIUM–MOLYBDENUM ALLOYS—ITS DEPENDENCE ON TEMPERATURE AND RATE OF DEFORMATION. G. A. Whitlow (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Aug. 1964. 16p.

The resistance to deformation of uranium-1,2, and 5 wt.% molybdenum alloys at several strain rates has been determined using a cam plastometer. In general the resistance to deformation decreases with increase in temperature. This information has been applied to the formulation of hot rolling schedules for the uranium-1 and 2 wt.% molybdenum alloys. (auth)

42013 (CONF-446-35) EFFECTS OF 1.0% SUPERIMPOSED MEAN STRAIN ON THE BENDING FATIGUE STRENGTH OF ZIRCALOY-4. D. F. Mowbray (Knolls Atomic Power Lab., Schenectady, N. Y.). May 1964. Contract W-31-109-eng-52. 28p.

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

Results are presented of an investigation to provide information on the effects of relatively large mean or static strains on Zircaloy-clad fuel elements and subassemblies used in pressurized-water reactors. The effects of superposition of 1.0% static strain on strain-cycled smooth and notched bending specimens was investigated. The investigation was conducted at room temperature and 600°F and in the cyclic life region of 10^5 to 10^6 cycles. Because of the reduction in fatigue at 600°F, it is concluded that the formerly used 0.2% static yield strength for making stress corrections in the fatigue analysis for Zircaloy at this temperature is not adequate. (J.R.D.)

42014 (JPL-TR-32-632) EFFECT OF GRAIN SIZE AND IMPURITIES ON TENSILE STRENGTH AND DUCTILITY OF TUNGSTEN FROM 2500 TO 5000°F IN VACUUM. J. L. Taylor, D. H. Boone, and O. W. Simmons (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). July 1, 1964. 13p.

The effect of grain size and impurity level on the tensile strength and ductility of powder-metallurgy tungsten was determined by comparing recrystallized coarse- and fine-grained undoped tungsten with recrystallized fine-grained doped tungsten. Tests were conducted in vacuum at a strain rate of 0.02/min from 2500 to 5000°F. Both fine-grained materials were about the same strength and both were stronger than the coarse-grained material. Ductility for the doped (higher impurity level) fine-grained tungsten was lower than for the undoped fine-grained tungsten in which stress-induced grain growth occurred more readily. Stress-induced grain growth correlates in a general way with ductility measured by either reduction in area or elongation. High and low values of stress-induced grain growth are associated with high and low values of ductility, respectively. In the intermediate temperature region, between approximately 50 and 65% of the absolute melting point, where a ductility minimum occurs, grain boundary sliding and its effects, i.e., void nucleation, growth, and intercrystalline fracture, appear to predominate to reduce ductility in both fine-grained materials. (auth)

42015 (NASA-TN-D-2464) INVESTIGATION OF THERMAL SHOCK RESISTANCE OF ZIRCONIA WITH METAL ADDITIONS. Alan Arias (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Sept. 1964. 75p.

Thermal shock resistances of compositions of ZrO_2 with 15 mole percent Ti prepared by various methods as well as that of stabilized zirconia were determined as a function of heat-transfer coefficient on disks with thermally insulated faces. The thermal shock resistance of one of the ZrO_2–Ti compositions was also calculated from the values of its physical properties, which were also determined. The values of thermal shock resistance obtained by both methods showed very good agreement for quenches from below the transformation range of ZrO_2. The discrepancy between the experimental and calculated values for quenches through the transformation range of ZrO_2 was traced to the elastoplastic behavior of these compositions on heating and cooling. Experiments to elucidate the mechanism by which Ti improves the thermal shock resistance of ZrO_2 were also carried out. (auth)

42016 (NP-14281(p.47-54)) SPECIFIC HEAT OF ZIRCONIUM BY A PULSE HEATING METHOD. A. H. Klein and G. C. Danielson (Ames Lab., Ames, Iowa).

The specific heat of iodide zirconium, from 25°C to the melting temperature of 1845°C, was determined by a pulse heating method. The $\alpha-\beta$ transformation from the hexagonal close-packed structure to the body-centered cubic structure occurred at 865°C. For $\alpha-$zirconium, the specific heat increased from 0.066 cal/g °C at 25°C to 0.082 cal/g °C at 865°C. Over the entire temperature range, the results are about three percent lower than those of Scott. For $\beta-$zirconium, where no previous measurements seem to have been reported above 1100°C, the errors were greater than for $\alpha-$zirconium. Approximate values of the specific heat in the $\beta-$range were determined, however, from our pulse data and from previously known information on the heat of transformation and on the temperature dependence of the resistivity. (auth)

42017 (NRL-6095) EFFECT OF OXYGEN ON CREEP-RUPTURE OF NIOBIUM. J. Stoop and P. Shahinian (Naval Research Lab., Washington, D. C.). Mar. 18, 1964. Contract AT(49-5)-1907. 16p. (AD-604337)

The creep-rupture properties of electron-beam-melted niobium with additions of oxygen up to 0.35 weight-percent were determined at 1900, 2300, and 2600°F at vacuums of 1×10^{-4} torr or better. Rupture life generally increased and minimum creep rate decreased as the level of oxygen was raised. There was no deleterious effect on ductility even with the high oxygen additions. Increases in hardness as a function of cold work and oxygen content were obtained. Activation energies for high-temperature creep were determined which showed good agreement with the reported experimental activation energies for self-diffusion. At 1900°F, but not at 2300 and 2600°F, an anomalous behavior occurred which was manifested by a rapid acceleration followed by a deceleration in the flow process. The irregularity, which is represented as a step in the creep curve, occurs only under certain combinations of temperature, stress, and oxygen content. It appears to be related to substructure formation, and not to recrystallization or grain growth. (auth)

42018 (NRL-6128) HIGH TEMPERATURE PROPERTIES OF SODIUM, POTASSIUM, AND CESIUM. Progress Report No. 14, January 1–March 31, 1964. J. P. Stone, C. T. Ewing, J. R. Spann, E. W. Steinkuller, D. D. Williams, and R. R. Miller (Naval Research Lab., Washington, D. C.). June 4, 1964. Contract NASA-C-76320. 52p. (AD-605277)

A program is in progress to measure various thermophysical properties of sodium, potassium, cesium, and their vapors. Experimental values are presented for the pressure-volume-temperature properties of sodium vapor and the density of sodium liquid. Two equations of state are advanced for sodium, and properties of the saturated and superheated vapor are derived from these equations by a thermodynamic treatment, which is presented in outline form. Enthalpy, entropy, specific volume, and specific heat and compositional information (weight fraction of dimer, weight fraction of tetramer, and average molecular weight) are tabulated for some 800 selected vapor states in the temperature range from 1625 to 2575°F, and in the pressure range from 0.2 to 26 atm. Similar tables for potassium, which were previously reported, were computed from a saturated liquid base. These tables have been recomputed using properties of the monomeric gas as a base, and are published in this report. (auth)

42019 (ORNL-3678) DEFORMATION TWINNING IN THE COLUMBIUM–VANADIUM ALLOY SYSTEM. D. O. Hobson (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 86p.

Thesis submitted to Univ. of Tennessee.

The columbium–vanadium alloy system is unusual in that it possesses good room-temperature ductility over most composition ranges combined with exceptionally high hardness, work-hardening rates, and strength. This combination of ductility with strength is due to the ability of the alloys to deform by twinning. A study was made on the effects of alloy composition, deformation temperature, heat treatment, and interstitial contamination on the tendency of the alloys to twin. The twinning transition temperature was found to vary with alloy composition with a maximum occurring at approximately 140°C in the 40% vanadium alloy. The temperature ranges over which the transitions occurred were extremely narrow, often less than 5°C. Alloy compositions from 20 to 70% vanadium were cold workable by rolling. The 10, 80, and 90% vanadium alloys cracked and were not twinnable. The addition of up to 7000 parts per million oxygen lowered the twinning transition temperature in all alloys tested. The curve geometry was directly related to the curve of transition temperature versus alloy composition for the uncontaminated alloys. The twinning transition temperature for a 30% vanadium alloy was found to increase with increasing annealing temperature. These effects were postulated to result from changes in dislocation density and distribution rather than from grain-size effects. Twinning and fracture were apparently unrelated in this system. Rather, the ability to deform by twinning, as opposed to the lack of ductility when twinning was absent, appeared to be a major factor in the good ductility of the alloys. This study suggests that twinning is an important and useful stress-release mechanism that may be the key to low-temperature ductility in body-centered cubic alloys. (auth)

42020 (PB-171809(Rev.)) CRYOGENIC MATERIALS DATA HANDBOOK. F. R. Schwartzberg, S. H. Osgood, R. D. Keys, and T. F. Kiefer (Martin-Marietta Corp. Aerospace Div., Denver). Aug. 1964. Contract AF33(657)-9161. 755p. (ML-TDR-64-280)

The completely revised "Cryogenic Materials Data Handbook" presently contains mechanical and physical property data on 62 metallic and nonmetallic materials for temperatures of –400 to 100°F. The Handbook also contains material, property, and accumulative indexes and reference list. Progress reports to update and maintain the Handbook will be issued semiannually. Materials include aluminum alloys, stainless steels, titanium alloys, superalloys, alloy steels, some miscellaneous metals and alloys, polymeric materials, and fiber-reinforced plastics. (R.E.U.)

42021 (TID-21107) TIME-DEPENDENT FRACTURE. Technical Report No. 18. C. C. Hsiao (Minnesota. Univ., Minneapolis. Inst. of Tech.). Sept. 1962. Contract AT(11-1)-532. 29p.

A brief account is given of some recent efforts here and abroad in studying the nature of rupture of solids. One of the important factors has been found to be the variation of time in the process of destruction of the solids. For a large variety of solids both in experiment and in theory the logarithm of time has shown to be linearly related with the applied uniaxial state of tensile breaking stress. This linear law has been established at least for some solids over a time range of a dozen decades from microseconds through months. Some suggestions are also given for future investigations on the time dependent fracture of solids. (auth)

42022 (TID-21138) AN EVALUATION OF THE ROLE OF DEFORMATION TWINNING IN THE PLASTIC DEFORMATION OF ZIRCONIUM. Twelfth Quarterly Progress Report. (Florida. Univ., Gainesville. Engineering and Industrial Experiment Station). Sept. 1964. Contract AT(38-1)-252. 17p.

The elastic after-effect in zirconium resulting from prestraining at 77°K was evaluated at various temperatures by micro-strain measurement techniques. The anelastic strain recovery believed to be associated with the stress induced movement of twin boundaries was found to be thermally activated over the range of temperature studied. The activation energy for the recovery mechanism was determined, and it was found to vary inversely with the amount of anelastic strain remaining in the specimen. (auth)

42023 (UCRL-7988) COMPRESSIVE CREEP OF CUSHIONING MATERIALS. J. K. Lepper and R. J. Jackson (California. Univ., Livermore. Lawrence Radiation Lab.). July 27, 1964. Contract W-7405-eng-48. 19p. (CONF-695-1)

From EIVR-10 Atomic Weapons Research Establishment Meeting, Aldermaston, Berks, Eng., Oct. 1964.

The compressive creep and stress-relaxation characteristics of several elastomeric cellular cushioning materials were investigated. Materials studied were two nonchemically blown silicone rubbers, one chemically blown silicone rubber, and two chemically blown polyurethane elastomers. The data for the silicone materials can be described by the empirical equation proposed by Professor Findley of Brown University, $\epsilon = \epsilon_0 + MT^n$, where ϵ is strain, T is time, and ϵ_0, M, and n are stress dependent constants. Silicone rubbers under compressive loading are described by the above equation with ϵ_0 held constant at zero and the following M and n values: M = 27 to 63 and n = 0.002 to 0.03 at δ = 30 psi. The creep behavior of the silicones was found to be linear on log strain-log time plots and nearly insensitive to temperatures as high as 200°F. The effect of cell size on the creep behavior has not been established. One-hour creep data appear to characterize silicones sufficiently well to be used for quality control purposes. The creep behavior of the polyurethanes is not linear on log strain-log time plots and is much more temperature sensitive than that of the silicones. (auth)

42024 (UJV-926/63) PŘISPĚVEK K PROBLEMATICE KOVOVÉHO JADERNÉHO PALIVA NA BASI PŘIRODNIHO URANU. (A Contribution to the Problem of Metallic Nuclear Fuel on the Basis of Natural Uranium). Jiří Nevák and Jan Truchlý (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1962]. 13p.

The requirements for metallic uranium as a fuel material are discussed. The importance of individual parameters and the possibility of improvement of the required characteristics by suitable heat treatment of technically pure uranium and of alloys of uranium are evaluated. The paper is concerned with alloys that from the point of view of parasitic absorption of thermal neutrons do not require the use of enriched uranium. It was established that with technically pure uranium there are limited possibilities of improving the required characteristics. The alloys seeming to be worthy of consideration were divided into two types. The contribution of both types of alloys is discussed considering the required characteristics and the difficulty of the technology. Both types show improvement with respect to technically pure uranium. The best results can be obtained with alloys of uranium with zirconium, niobium, or molybdenum, which are suitable for incorporating into plate structures. (TTT)

42025 (AI-Trans-49) SUPERCONDUCTIVITY AND PHASE TRANSFORMATION IN TITANIUM ALLOYS. I. ADMIXTURES OF VANADIUM, NIOBIUM AND MOLYBDENUM. Christoph Julius Raub and Ulrich Zwicker (California. Univ., San Diego, La Jolla and Forschungsinstitut für Edelmetalle und Metallchemie, Schwäbisch-Gmünd, Germany). Translated by Anthony Cornell (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). [1963]. 10p.

Studies were made of the effects of intermediate states formed by cold working and phase transformations on the transition temperature for the following alloys: Ti−16 V−3 Al, Ti−16 Mo, and Ti−33 Nb. Aging at both low and high temperatures was studied. It is concluded that the transition temperature is determined by the concentration of the transition metals in the superconducting zones of the α- or β-matrix, or the metastable transition phases coherent with this matrix. (D.L.C.)

42026 (ORNL-tr-296) THEORY OF THE FORMATION OF S-SHAPED KINK BANDS IN PLASTICALLY DEFORMED METAL CRYSTALS. II. DISLOCATION ARRANGEMENT, STABILITY AND COURSE OF DEVELOPMENT OF THE KINK BAND. Hartwig Mueller. Translated for Oak Ridge National Lab., Tenn., from Z. Metallk., 50: 356-63(1959). 18p.

Information is presented to show that equilibrium distances in crystals adjust themselves in kink bands between dislocations under the influence of external stress and the repelling forces between dislocations of equal sign. The width of the kink bands conditioned thereby depends on the distance between the actuated slip planes over the extent of the repelling forces between dislocation walls. A model is included to account for the effects of deformation temperature, rate, tensile orientation, and the type of deformation on the occurrence and dimensions of kink bands. (J.R.D.)

42027 Sc_5Ga_3 AND Y_5Ga_3 WITH $D8_8$ STRUCTURE. O. Schob and E. Parthe (Univ. of Pennsylvania, Philadelphia). Acta Cryst., 17: 1335-6(Oct. 10, 1964).

Homogeneous samples of Sc_5Ga_3 and Y_5Ga_3 were synthesized by induction melting of the metals mixed in proper weight proportions in a boron nitride crucible under argon. The x-ray diffraction patterns of the gallides were indexed with a hexagonal unit cell with dimensions a = 8.074 ± 0.002, c = 5.951 ± 0.002 A with c/a = 0.737 for Sc_5Ga_3 and a = 8.576 ± 0.006, c = 6.479 ± 0.004 A with c/a = 0.755 for Y_5Ga_3. The systematic extinctions hOhl with l = 2n + 1 led to possible space groups $P6_3/mcm$ (D_{6h}^3), $P\bar{6}c2$ (D_{3h}^2), $P6_3cm$ (C_{6v}^3), and $P\bar{3}c1$ (D_{3d}^4). Visual comparison with the powder patterns of Sc_5Ge_3 and Y_5Ge_3 suggested that the gallides are isotopic with the germanides, which crystallize with the $D8_8$ structure. (P.C.H.)

42028 PERMEABILITY OF TUNGSTEN MATRICES AS A FUNCTION OF DENSITY, PARTICLE SIZE, AND SHAPE. Allen T. Robinson (Naval Ordnance Test Station, China Lake, Calif.). Am. Soc. Metals, Trans. Quart., 57: 650-7 (Sept. 1964).

Permeability measurements were made on tungsten compacts ranging from 63 to 81% of theoretical density, with fluids whose viscosities were selected to approximate those of molten metals. Permeability of spherical tungsten particle compacts (50, 100, and 420 microns) varied with particle size of the powder used to prepare the compact and the density of the compact, whereas permeability of granular tungsten particle compacts (10 to 30 microns) was a function of matrix density alone. (auth)

42029 RECRYSTALLIZATION BEHAVIOR OF COLD ROLLED TD–NICKEL. M. C. Inman, K. M. Zwilsky, and D. H. Boone (Pratt and Whitney Aircraft, North Haven, Conn.). Am. Soc. Metals, Trans. Quart., 57: 701-13(Sept. 1964).

The recrystallization behavior of TD–Nickel, cold rolled 93%, was investigated. It was found that hardness decreases to one-half the original value after annealing at 600°C for 1 hr. Thereafter the hardness remains practically constant during annealing at temperatures to the melting point. The drop in hardness was related to recrystallization and grain growth as shown by optical and transmission electron micrographs. The crystallographic orientation of grains in the cold-rolled and recyrstallized condition was established by pole figure determinations. A size distribution curve for thoria particles was established. The results are compared to and discussed with reference to published data for pure nickel. (auth)

42030 THE DENSITY OF LIQUID BERYLLIUM FROM ITS MELTING POINT (1556 K) TO 2200 K AND ITS EXPANSION ON MELTING. A. V. Grosse and J. A. Cahill (Temple Univ., Philadelphia). Am. Soc. Metals, Trans. Quart., 57: 739-42(Sept. 1964).

The density of liquid Be was measured by the maximum bubble pressure method between its melting point (1556°K) and 2200°K. A value of 1.690 g/cc was determined. The value for the slope of the density-temperature relation was determined as 11.62×10^{-5} g/cc/°K. Using the value of 1.690 g/cc for the liquid at the melting point with the value of 1.808 g/cc for the solid 32° below the melting point, a change in volume on fusion of 6.97 was calculated to be 7.0% expansion on melting. (P.C.H.)

42031 DIFFUSION BARRIERS FOR TANTALUM AND COLUMBIUM. E. M. Passmore (Avco Corp., Wilmington, Mass.), J. E. Boyd, and B. S. Lement. Am. Soc. Metals, Trans. Quart., 57: 760-6(Sept. 1964).

Based mainly on considerations of phase relations, nine barrier— tantalum-base combinations and eight barrier— niobium base combinations were selected for experimental evaluation of relative extents of interdiffusion. Metallographic examination and microhardness measurements of the 17 combinations revealed wide variations in the extent of interdiffusion. After diffusion-annealing treatments of 4 hr at 1700°C or 3 hr at 1800°C, the interdiffusion zone thicknesses varied from 30 μ for the Ta–Os combination to over 600 μ for the Nb–Hf and Ta–Hf combinations. Based primarily on the extent and character of interdiffusion, tungsten and rhenium were selected as promising barrier metals for both Ta and Nb. Ruthenium was selected as a promising barrier only for tantalum, while osmium and zirconium were selected as promising for Nb-base metals. (auth)

42032 THE RECRYSTALLIZATION OF ALPHA–PLUTONIUM. L. Ianniello (Argonne National Lab., Ill.). Am. Soc. Metals, Trans. Quart., 57: 768-9(Sept. 1964).

The problems of recrystallizing α –Pu are discussed along with some experiments that point to the temperature of recrystallization. After several experiments failed to produce recrystallization in α –Pu, several rolled specimens were annealed for short periods at 120°C and examined for signs of recrystallization. Metallographic and x-ray evidence pointed to recrystallization and was encouraging since with purer material the recrystallization temperature would be expected to be below the transformation temperature. The Pu used contained 0.14 at. % analyzed impurities. A linear interpolation on the basis of compressibility places the recrystallization temperature at 113°C, whereas on the basis of melting point that temperature is 73°C. It was concluded that the experimental observation of recrystallization temperature being in the vicinity of the transformation temperature is not reasonable. (P.C.H.)

42033 VACANCIES IN QUENCHED MOLYBDENUM SINGLE CRYSTALS. J. D. Meakin (Franklin Inst., Philadelphia), A. Lawley, and R. C. Koo. Appl. Phys. Letters, 5: 133-5(Oct. 1, 1964).

The observation of dislocation loops in quenched Mo, thought to be the first direct evidence of defect structures produced by the aggregation of quenched-in vacancies in a b-c-c metal, is reported. (C.E.S.)

42034 PROPERTIES AND REQUIREMENTS OF ZIRCALOY-2 AND STEEL FOR CANNING NUCLEAR FUEL ELEMENTS. Brian Mills (Sandvik Steel Research Centre, Sandviken, Sweden). Belgicatom, Assoc. Belge Develop. Pacifique Energie At., Bull. Inform. No. 50, 75-82(June 1964).

The results are presented of studies on the effect of cold work, annealing temperature, and oxygen content on the mechanical properties of Zircaloy-2 and on the effect of manufacturing techniques on the orientation of hydrides formed in the material during service. Inspection and testing of Zircaloy-2 fuel cans are also described. A research program on five austenitic steels and a ferritic steel is then outlined, with a comparison of the steels with respect to physical and mechanical properties. (D.C.W.)

42035 FURTHER INVESTIGATION OF HIGH-TEMPERATURE COBALT–TUNGSTEN ALLOYS FOR AEROSPACE APPLICATION. John C. Freche, Richard L. Ashbrook, and Gary D. Sandrock (Lewis Research Center, Cleveland). Cobalt, No. 24, 125-7(Sept. 1964).

Improvements brought about in the strength of Co-25 W-1 Ti-1 Zr-0.4 C by the additions of 3% Cr and 2% Re are discussed. Particularly significant is the fact that, in addition to comparing favorably in high-temperature strength with the most recent cast commercial superalloys, the new Co–W base alloys is still readily rollable. The data presented indicate that the Co–W base alloys have considerable potential for aerospace and other specialized applications. (P.C.H.)

42036 NUCLEAR MAGNETIC RESONANCE IN METALS AND ALLOYS. S. S. Dharmatti and R. Vijayaraghavan (Tata Inst. of Fundamental Research, Bombay). Current Sci. (India), 33: 449-54(Aug. 5, 1964).

Nuclear magnetic resonance experiments on sodium alloys, platinum alloys, ferromagnets, and rare earth alloys are discussed. Knight shifts in Na and Pt and temperature-dependent shifts in transition metals and rare earth alloys are described. (P.C.H.)

42037 THERMAL EXPANSION OF CERTAIN TRANSITION METALS AND THEIR ALLOYS. M. P. Arbuzov and I. A. Zelenkov (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Fiz. Metal. i Metalloved., 18: 311-12(1964). (In Russian)

Thermal expansion coefficients were found for pure Ni, Fe, Al, Mo, Co, and Ni alloys at 480 to 530°C. (R.V.J.)

42038 THERMAL RESISTANCE OF METALLIC CONTACTS. Yu. P. Shlykov and E. A. Ganin (Moscow Univ.). Intern. J. Heat Mass Transfer, 7: 921-9(Aug. 1964).

A calculation method for thermal resistance of a contact between two rough metal surfaces with different compressing forces and quality of finishing is considered. The results of analytical calculation are correlated with experimental data. (auth)

42039 ELECTRICAL CONDUCTIVITY IN THE SYSTEM $ZrO_2-CaZrO_3$. T. Y. Tien (Westinghouse Research Labs., Pittsburgh). J. Am. Ceram. Soc., 47: 430-3(Sept. 21, 1964).

The electrical conductivity of compositions in the system $ZrO_2-CaZrO_3$ was examined. The composition of maximum conductivity in this system is within the cubic solid-solution region close to the low-calcia cubic solid-solution phase boundary. The conductivity decreases from the single-phase cubic solid solution to both of the adjacent two-phase regions; the decrease is more rapid on the ZrO_2-rich two-phase side. This effect is discussed on the basis of differing microstructures. (auth)

42040 STRUCTURAL AND MAGNETIC PROPERTIES OF SPUTTERED NiFe FILMS GROWN IN A DC DISCHARGE ENVIRONMENT. Eric Kay (IBM Research Lab., San Jose, Calif.). J. Appl. Phys., 35: 2936-42(Oct. 1964).

Experimental evidence is presented which verifies Middelhoek's recent extension of the Néel theory relating the coercivity with film thickness variations. Under special preparatory conditions "inverted" Fe–Ni films on glass substrates were produced with excellent reproducibility. Partial oxidation leading to antiferromagnetic inclusions was shown to be absent. Resolution of the substrate temperature control problems using metal substrates in the plasma environment established that a uniaxial anisotropy can only be induced into sputtered Fe–Ni films over a limited temperature region. Temperature control during film growth also made possible a direct correlation of film morphology with the magnitude and uniformity of the dispersion of the easy axis of magnetization and the resultant critical field for wall motion H_c. Typical coercivity H_c, anisotropy field strength H_K, and dispersion measurements on 700-Å Fe–Ni films on very smooth 25 cm² Ag:Cu–SiO substrates gave: $H_c = 1.92 \pm 0.07$ Oe, $H_K = 2.85 \pm 0.03$ Oe, dispersion = 1.0 ± 0.0°. Special problems pertaining to film growth in a plasma environment are discussed. A typical Lorentz micrograph of a sputtered Fe–Ni film deposited directly onto a microscope grid is given. (auth)

42041 STB MODEL AND TRANSPORT PROPERTIES OF PYROLYTIC GRAPHITES. Claude A. Klein (Raytheon Research Div., Waltham, Mass.). J. Appl. Phys., 35: 2947-57(Oct. 1964).

It is shown that a coherent description of pyrolytic graphite (PG) layer-plane phenomena can be based on a parabolic two-band system with cylindrical equal-energy surfaces. In this simple two-band (STB) model, band overlap and effective mass must be interpreted as phenomenological parameters to be derived from experiments on highly heat-treated pure PG. With p-type (boron-doped) specimens, the objective is to describe the situation from the shift of the Fermi level, on the assumption that the presence of trapping centers would not inject major perturbations in the band structure. (auth)

42042 THE DETERMINATION OF THE DENSITY OF Ta, Nb, AND ANODICALLY FORMED Ta_2O_5 AND Nb_2O_5. A. J. Schrijner and A. Middlehoek (Philips' Gloeilampenfabrieken, Zwolle, Netherlands). J. Electrochem. Soc., 111: 1167-9(Oct. 1964).

By refining a previous method, the density of Ta, Nb, Ta_2O_5, and Nb_2O_5 was determined. It was found that the forming electrolyte has some influence on the density of the Ta_2O_5 formed by anodizing. This can be interpreted by assuming that some electrolyte has been built in. (auth)

42043 DIFFUSION OF OXYGEN IN HAFNIUM. J. P. Pemsler (Kennecott Copper Corp., Lexington, Mass.). J. Electrochem. Soc., 111: 1185-6(Oct. 1964).

The diffusion coefficient of oxygen in Hf was redetermined by the anodization technique. Measurements were performed within a single grain of Hf to avoid the necessity of estimating average colors, and hence average thicknesses, of interference films on a large number of grains in a polycrystalline sample. A least square solution of the data from anodic dissolution measurements gave a value for the diffusion coefficient as $D = 0.660 \exp(-50,820 \pm 240/RT)$. Other data on the diffusion of oxygen in Hf are evaluated. (P.C.H.)

42044 A TECHNIQUE FOR STUDYING OXYGEN DIFFUSION AND LOCATING OXIDE INCLUSIONS IN METALS BY USING THE PROTON RADIOACTIVATION OF OXYGEN-18. Ralph H. Condit and J. Birch Holt (Univ. of California, Livermore). J. Electrochem. Soc., 111: 1192-4(Oct. 1964). (UCRL-7731-T)

An activation technique is described for studying oxygen diffusion and locating oxide inclusions in metals. A MgO bicrystal was bombarded with 2.7 Mev protons. Reasons are given for using a 2.7 Mev beam, and interfering elements are discussed. A microdensitometric inspection of the autoradiograph of irradiated MgO indicated penetration of oxygen at the grain boundary to the full 20 μ depth with the likelihood that it went yet deeper. (P.C.H.)

42045 THERMAL CONDUCTIVITY OF BERYLLIUM AT 15 TO 1800°K. J. Elston, J. De Goer, and Z. Mihailovic (CEN, Grenoble, France and CEN, Saclay, France). J. Nucl. Mater., 11: 333-4(Apr. 1964). (In French)

The thermal conductivity of three samples of BeO was measured at 15 to 1800°K. Two samples were prepared by sintering under stress and the third sample by natural sintering with the addition of 0.6% CaO. The results were corrected for density. The conductivity maximum was found near 80°K and was of the order of 15 watts/cm/°K. The conductivity of the sample containing CaO was noticeably lower at low temperatures than that of the other samples. The samples containing CaO had a thermal conductivity coefficient about 6% lower than the other samples at high temperatures. All samples used BeO of nuclear purity as starting material. (J.S.R.)

42046 CaF_2 AS MODEL SUBSTANCE FOR DIFFUSION PROCESSES IN UO_2. Hj. Matzke (Technische Hochschule, Brunswick). J. Nucl. Mater., 11: 344-7(Apr. 1964). (In German)

CaF_2 was tested as a model substance in the study of the diffusion processes in UO_2. The mobility of anions and the diffusion of rare gases were determined using ^{18}F and ^{37}Ar. The results of the mobility studies with ^{18}F showed the effects of evaporation phenomena at high temperatures. No relation between the various diffusion processes could be detected. The cation diffusion required an activation energy that was similar to that required for rare gases. Diffusion of anions required a lower activation energy. A separate diffusion process was assumed for the rare gas in the use of KCl as model substance for UC. (J.S.R.)

42047 STUDY OF THE SYSTEM URANIUM DIOXIDE–MOLYBDENUM. E. Gebhardt and G. Ondracek (Max Planck-Institut für Metallforschung, [Stuttgart]). J. Nucl. Mater., 12: 113-14(May-June 1964). (In German)

The constitution and properties of the UO_2–Mo system were investigated. The preparation of the samples by cold pressure and sintering methods is described. No indication of the occurrence of reactions between the system components could be detected in extended annealing. The specific electric resistance of sintered samples decreased with increasing Mo concentration. The linear thermal expansion coefficient decreased with increasing Mo content. The bend-fracture and elasticity modulus were not linear. The bend fracture was about 3 kp/mm^2 and the elasticity modulus 5000 kp/mm^2 at the minimum. (J.S.R.)

42048 THE PLUTONIUM-ZINC SYSTEM. E. Daniel Albrecht (Los Alamos Scientific Lab., N. Mex.). J. Nucl. Mater., 12: 125-30(July 1964).

The portion of the plutonium-zinc system lying between 65 and 98 at. % zinc was reinvestigated. Metallographic and x-ray diffraction methods were used to examine specimens of each of the four compounds ($PuZn_2$, Pu_2Zn_9, $PuZn_8$, and Pu_2Zn_{17}) found in the system. Alloy specimens were subjected to extended heat treatments at temperatures between 324 and 817°C to elucidate phase relationships at elevated temperatures. The melting points of the two compounds that melt congruently ($PuZn_2$ and Pu_2Zn_9) were determined. (auth)

42049 DIFFUSION OF NITROGEN IN URANIUM DIOXIDE. H. M. Ferrari (Westinghouse Electric Corp., Pittsburgh). J. Nucl. Mater., 12: 142-4(July 1964).

Diffusion kinetics for nitrogen in UO_2 pellets were determined experimentally over the temperature range 1000-1600°C. The fraction of nitrogen liberated from uniformly dispersed uranium nitride particles in UO_2 was measured on carefully characterized pellets. The diffusion coefficient for nitrogen in UO_2 can be represented by the expression: $D = 2.25 \times 10^{-9} \exp(-33\,400/RT)$ cm^2/sec. (auth)

42050 MECHANISMS OF DEFORMATION OF ALPHA PLUTONIUM. B. Spriet (CEN, Fontenay aux Roses, France). J. Nucl. Mater., 12: 159-66(July 1964). (In French)

The modes of plastic deformation under compression of α plutonium were studied. Three slip systems, cross slips, deformation bands, and one twinning system (with another possible one) were established. The influence of temperature and of orientation on these mechanisms was sketchily examined. (auth)

42051 THE EFFECT OF TERNARY ADDITIONS ON THE MICROSTRUCTURES OF DILUTE U-Mo ALLOYS. S. Nicholson, D. G. Harris, and J. J. Stobo (International Research and Development Co. Ltd., Newcastle upon Tyne, Eng.). J. Nucl. Mater., 12: 173-83(July 1964).

Dilute ternary uranium alloys of the U-Mo-Fe, U-Mo-Al, U-Mo-Ru, U-Mo-Cr, and U-Mo-Nb systems were heat treated to give lamellar or divorced ($\alpha + \gamma$) microstructures. The U-Mo-Nb system is the only one in which the γ/α ratio is higher than in the binary U-3.6 at. % Mo alloy when the nuclear penalties due to alloying, as measured by reactivity loss, are equal. However, thermal stability tests at 500°C show that the binary U-3.6 at. % Mo alloy regains its supremacy as regards γ/α ratio, after 500 hours. (auth)

42052 THE THERMAL EXPANSION OF GRAPHITE WITHIN THE LAYER PLANES. E. A. Kellett and B. P. Richards (General Electric Co. Ltd., Wembly, Middx, Eng.). J. Nucl. Mater., 12: 184-92(July 1964).

The thermal expansion of graphite within the layer planes was investigated by x-ray diffractometer and powder diffraction techniques. Direct measurements of the a lattice dimension over the whole range of temperatures from -196 to 3000°C were made for the first time. Two specimens were studied, one a spectroscopic electrode material of $p \approx 0.2$ and the other a highly orientated pyrolytic graphite. The variation of the coefficient of thermal expansion α_a was computed from the measured variation with temperature of the a lattice dimension. It is shown that above about 400°C there is a progressive expansion of the interatomic spacings in the basal plane with α_a approaching a limiting value of 1.2×10^{-6} per °C. This provides the first experimental confirmation of theoretical prediction. Below 400°C there is an expansion with decrease in temperature. Below 0°C the rate of expansion rapidly decreases and a limiting value of the a lattice parameter is approached at -196°C. These findings are consistent with the results of others who found a minimum in the a-dimension at about 400°C. The experimental data are compared with those predicted by theory and with those obtained by others. (auth)

42053 TWIN FORMATION ON URANIUM CARBIDE CRYSTALS. E. M. Hoerl (Osterreichische Studiengesellschaft für Atomenergie [GmbH, Vienna]). J. Nucl. Mater., 12: 193-7(July 1964). (In German)

The formation of mirror twins with a $\{112\}$ twin plane was observed in tetragonal UC_2 crystals. The crystallographic orientation of the lamellar precipitates found in annealed crystals was determined to be parallel to (001). The lattice distortion in the matrix crystal caused by the formation of these precipitates was analyzed. (auth)

42054 THE INFLUENCE OF HEAT-TREATMENT ON THE CREEP STRENGTH OF THE MAGNESIUM-ZIRCONIUM ALLOY ZA. C. C. Smith, A. M. Taylor, and P. Greenfield (English Electric Co. Ltd., Whetstone, Leicester, Eng.). J. Nucl. Mater., 12: 198-207(July 1964).

The creep strength of the magnesium-zirconium alloy ZA was examined at 400°C and 200 psi after heat-treatment at 600°C in different atmospheres. It was found that while improvements in the creep properties are obtained by an homogenization anneal and grain growth, further significant improvements in creep strength can be obtained by precipitation of the zirconium in the ZA as zirconium hydride. This precipitate can be formed during the preanneal at 600°C or during creep testing at 400°C by reaction with hydrogen or moisture in the annealing or testing atmospheres. It is shown that precipitation of zirconium hydride is not by itself sufficient to produce an improvement in creep strength. Grain growth is also a requirement for improved creep properties. (auth)

42055 "PEST" DEGRADATION IN BERYLLIDES, SILICIDES, ALUMINIDES, AND RELATED COMPOUNDS. J. H. Westbrook and D. L. Wood (General Electric Research Lab., Schenectady, N. Y.). J. Nucl. Mater., 12: 208-15(July 1964).

It is shown that grain boundary hardening, arising from local concentrations of oxygen or nitrogen and developed by heating the compounds in air, is an indicator of susceptibility to pest degradation. Among the observations made on $MoSi_2$, NiAl, various beryllides, and TiB_2 were the effects of stoichiometry and heat treatment. On the basis of experimental observations, a model is proposed in which such degradation results from preferential intergranular diffusion of a gaseous element, coupled with a temperature dependent hardening reaction. (P.C.H.)

42056 THE KINETICS OF THE $\beta \to \alpha$ TRANSFORMATION IN PLUTONIUM-TITANIUM ALLOYS. L. G. T. Davy and J. S. White (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nucl. Mater., 12: 221-5(July 1964).

An investigation was made of the kinetics of the $\beta \rightarrow \alpha$ transformation in Pu–Ti alloys containing 0.23, 0.82 and 1.05 at. % Ti. The rate of the transformation of the beta phase was followed using a high precision technique based upon the measurement of the change of electrical resistance during transformation. The results suggest that depending upon the temperature, the $\beta \rightarrow \alpha$ change proceeds by one of two distinct mechanisms. At low temperatures the activation energy for the change appears to be independent of composition and has a value of 2 kcal/mole. The low value is indicative of a martensitic transformation. It was not possible to identify the other reaction mechanism but it is tentatively proposed that it is massive transformation. (auth)

42057 THE PLUTONIUM–GALLIUM SYSTEM. F. H. Ellinger, C. C. Land, and V. O. Struebing (Los Alamos Scientific Lab., N. Mex.). J. Nucl. Mater., 12: 226-36 (July 1964). (LADC-6221)

The plutonium–gallium equilibrium diagram was constructed from the results of thermal, dilatometric, micrographic, and x-ray diffraction studies. The maximum solubilities of gallium in δ- and ϵ-plutonium are about 12.5 and 20 at.%, respectively. The δ phase is stabilized to room temperature by the solution of 2 or more at. % gallium. Six intermediate phases, namely, $Pu_3Ga(\zeta')$, Pu_5Ga_3, PuGa, Pu_2Ga_3 (?), $PuGa_2$, and $PuGa_3$ (μ'), are stable at room temperature, and 3 phases, namely, Pu_3Ga (ζ), $PuGa_3$ (μ), and η are stable at elevated temperatures. The η solid solution exists from about 18 to 42 at. % gallium, depending on temperature. (auth)

42058 THE CREEP BEHAVIOUR OF A MAGNESIUM/0.3 wt % ZIRCONIUM ALLOY AT 400 AND 450°C IN CARBON DIOXIDE. C. Grown (International Research and Development Co. Ltd., Newcastle upon Tyne, Eng.). J. Nucl. Mater., 12: 243-7(July 1964).

Studies were made to determine whether reducing the Zr content would improve ductility at high temperatures while retaining the desirable properties of ZA (Mg-0.5 wt % Zr.). Creep tests were made at 400 and 450°C and the stress rupture tests at 200°C in CO_2 containing 200-300 ppm by weight of water vapor. The creep behavior of the Mg-0.3 wt % Zr alloy closely resembled that of the Mg-0.5 wt % Zr alloy. The 0.3 wt % Zr alloy hardened during creep testing at 450°C and became more creep resistant than at 400°C. Stress rupture tests at 200°C showed that there is a loss of ductility after creep testing at 450°C, which must be partially attributed to the hardening reaction. The loss of ductility was not however so great as that in ZA alloy. The differences in behavior between specimens tested at 400 and 450°C can probably be explained by the differences in the rates of hydrogen formation possibly coupled with difference in the properties of the oxide films formed at the two temperatures. (P.C.H.)

42059 THE EFFECT OF GRAIN SIZE ON THE TENSILE AND COMPRESSIVE CREEP DEFORMATION OF A MAGNESIUM–MANGANESE ALLOY AT 450°C. T. C. Wells and C. Brown (International Research and Development Co. Ltd., Newcastle upon Tyne, Eng.). J. Nucl. Mater., 12: 248-50(July 1964).

Test specimens were fabricated from the Mg–Mn alloy AM503S, containing 0.57-0.67 wt % Mn, which had been heat treated for 4 hr at 560°C to give improved creep resistance. Sets of three specimens of differing grain sizes were subjected to 224 psi compressive stress at 450°C in CO_2. The deformation was least in the specimens of the coarsest grain size. A pseudoprimary creep state that followed each thermal cycle formed an appreciable part of the total deformation. All the compression specimens became barrelled during testing, all suffered some nonuniform deformation because of non-axial loading, and in coarse grained specimens there was some surface cracking. The mean deformation rates of the tensile specimens were much more dependent on the grain size than were those of the compression specimens and were lower in the full size than in the miniature specimens. In both cases subgrains and grain boundary serrations formed together with cavitation, principally in the necked portions or in the vicinity of the fracture. The results suggest that the effect of grain size on the creep strength of heat treated AM503S at 450°C is much less marked under axial compressive stress than would be inferred from the results of tensile creep tests. (P.C.H.)

42060 EFFECT OF TEMPERING AND GRAIN DIMENSION ON THE MECHANICAL PROPERTIES OF S.A.P. D. Nobili and P. Guyot (EURATOM, Ispra, Italy). J. Nucl. Mater., 12: 251(July 1964). (In French)

The mechanical properties of extruded, cold rolled, annealed, and recrystallized SAP 960 were determined at 20 to 600°C in order to study the influence of tempering and grain dimensions on the plastic deformation. It was observed that the cold-rolled textures were analogous for the SAP 930 and 960; more if the annealing is practically ineffectual for the former, for the latter it entrains the tempering of an important fraction of the open dislocations as well as augmentation of the grain size from 0.3 to 0.5 μ. It concerns a phenomena of actual grain growth without any change in texture. Recrystallization of the samples had no further influence on the ductility, which seemed independent of the crystal dimension. (P.C.H.)

42061 A PRELIMINARY INVESTIGATION INTO THE PROPERTIES OF A MAGNESIUM–ALUMINIUM–SILICON ALLOY. C. Brown and T. C. Wells (International Research and Development Co. Ltd., Newcastle upon Tyne, Eng.). J. Nucl. Mater., 12: 252-6(July 1964).

A Mg-0.9 wt % Al-0.009 wt % Be-0.1 wt % Si alloy was tested at 450 and 200°C to determine the effect of the presence of Mg_2Si particles on the creep properties and the grain size stability relative to that of normal Magnox A12 (Mg-0.7-0.9 wt % Al-0.005-0.030 wt % Be). In particular the effect of creep deformation at 450°C on the subsequent ductility of the alloy at 200°C was determined. An as-extruded alloy consisted of strings of Mg_2Si particles in a matrix of uniform grain size (mean grain dia 0.005 cm). Considerable selective grain growth occurred in the center of the creep-tested specimens to give mean grain diameters adjacent to the fractures in the range 0.015-0.521 cm. The level of cavitation was high (>100) in all specimens, even in non-ruptured specimens, which had cavities at the boundaries of some of the larger grains. It was concluded that this alloy would be unsuitable for canning fuel elements that are to be shuffled between high and low temperature zones of a reactor. (P.C.H.)

42062 AN APPARATUS FOR ELECTRON BEAM STUDIES AT LIQUID HELIUM TEMPERATURES. A. E. Curzon and A. T. Pawlowicz (Imperial Coll. of Science and Tech., London). J. Sci. Instr., 41: 552-4(Sept. 1964).

The apparatus described uses liquid helium as a refrigerant material and enables transmission and reflection electron diffraction studies to be carried out in the temperature range from about 6 to above 77°K. The temperature of the specimens is controlled by means of an electric heater. Specimens can be formed in situ by condensing gases or vapors onto a suitable substrate material. It is possible to study the intermediate state in superconductors by means of the electron beam, which is deflected by the magnetic fields associated with persistent currents. (auth)

42063 IMPREGNATION IMPROVES CARBON–GRAPHITE. Mater. Design Eng., 60: 93-5(Sept. 1964).

The effects of impregnation on lower permeability, better oxidation resistance, and higher strength, hardness, wear, and chemical resistance of carbon–graphite base materials are discussed. The type of impregnant established the special properties that can be obtained. Typical impregnants used are: synthetic resins (thermosetting), chemical salts, babbit, copper, copper and lead alloy, silver, oil, zinc, wax, ceramics, and various combinations of these materials. Comparative properties of impregnated and conventional carbon and graphite are tabulated. (P.C.H.)

42064 BERYLLIUM–ALUMINUM ALLOYS— PROMISING NEW STRUCTURAL METALS. Raymond W. Fenn, Jr., Donald D. Crooks, and Ervine E. Underwood (Lockheed Aircraft Corp., Palo Alto, Calif.). Mater. Design Eng., 60: 103-5(Sept. 1964).

The engineering performance of newly developed Be–24-43% Al alloys is reported. The alloys are a result of extensive research to find a material similar to Be in high modulus and low density, but with improved ductility for greater structural integrity and to facilitate fabrication. The alloys also have several other advantages, including relative insensitivity to surface damage, freedom from tedious chemical etching after machining, and improved formability, machinability, and weldability over Be. Data on the mechanical and physical properties of Be–Al alloys at 75°F are tabulated. (P.C.H.)

42065 TEMPERATURE EFFECT ON MECHANICAL PROPERTIES OF PURE METALS. B. A. Klypin (Central Scientific Research Inst. of Ferrous Metallurgy, [Academy of Sciences], USSR). Metalloved. i Term. Obrabotka Metal., No. 7, 7-11(July 1964). (In Russian)

The mechanical properties of Mo, Nb, and Ni were tested at -196 to 2800°C. (R.V.J.)

42066 A STUDY OF $UC_{1-x}O_x$. [PART] II. Shingo Namba, Shosuke Imoto, and Tadao Sano (Osaka Univ.). Nippon Genshiryoku Gakkaishi, 6: 441-7(Aug. 1964). (In Japanese)

A study was made on the formation of $UC_{1-x}O_x$ through the reaction of UC and UO_2 or UC_2 and UO_2 in several composition ratios under the pressure of CO gas of $10^{-3} \sim 10^{-4}$ mm Hg and a temperature variation of 1200 ~ 1750°C for 2 ~ 16 hr. The main phase of the reaction product was identified as $UC_{1-x}O_x$, where x covered the range of 0 ~ 0.8 depending upon the initial composition ratio UO_2/UC or UO_2/UC_2. The lattice parameter of the $UC_{1-x}O_x$ decreased with the increase in x and also in the reaction temperature except for the reaction at 1200°C, in which the parameter was found to be almost the same as that of UC. The variation of the lattice parameter is understood to be due to the solubility range of U, C, and O in $UC_{1-x}O_x$, which is a function of the reaction temperature. A thermodynamical discussion is given on the equilibrium of $UC_{1-x}O_x$ and CO gas in reference to the stability of $UC_{1-x}O_x$. The free energy of formation of UO was close to half that of UO_2 under the theoretical assumption. From this fact, the stable existence of pure UO may never be out of consideration. (auth)

42067 ZIRCONIUM AND ITS APPLICATIONS IN ATOMIC INDUSTRY. R. L. Bensimon and G. S. Simonovitch. Nucleus (Paris), 5: 194-8(May-June 1964). (In French)

The properties of Zr and Zr alloys that make them suitable for reactor components are reviewed, including mechanical properties, behavior under irradiation, corrosion resistance, and low thermal neutron capture cross section. Applications of Zr in reactors are then indicated, after a brief comparison of Zr and other structural materials. (D.C.W.)

42068 ELECTRICAL CONDUCTION IN RARE-EARTH MONOSELENIDES AND MONOTELLURIDES AND THEIR ALLOYS. F. J. Reid, L. K. Matson, J. F. Miller, and R. C. Himes (Battelle Memorial Inst., Columbus, Ohio). Phys. Chem. Solids, 25: 969-76(Sept. 1964).

The refractory (melting points, 1700–2100°C) rare-earth monoselenides and monotellurides were observed to fall into two general classes: the type II of normally dipositive elements such as samarium and ytterbium, and the type III of normally tripositive elements such as neodymium and gadolinium. The former exhibit high resistivities and negative temperature coefficients of resistance while the latter appear to be degenerate semiconductors with positive temperature coefficients of resistance. Alloys containing both types of rare-earth elements (e.g., SmSe–NdSe) exhibit intermediate properties. As SmSe is replaced progressively by NdSe, resistivity decreases from 10^3 to about 10^{-5} Ω-cm with a precipitous drop of 10^4 at 11–13% NdSe. Crystallographic models were employed to examine the distribution of neodymium atoms for various alloy compositions. Possible implications with respect to the observed electrical properties of the alloys are discussed. (auth)

42069 EFFECTS OF PRESSURE ON THE ELECTRICAL RESISTANCE OF CERTAIN METALS. H. D. Stromberg and D. R. Stephens (Univ. of California, Livermore). Phys. Chem. Solids, 25: 1015-22(Sept. 1964). (UCRL-7536)

The four-lead electric resistance system previously described by Stromberg and Jura was employed to measure the room temperature resistance vs pressure of praseodymium, europium, gadolinium, terbium, dysprosium, erbium, ytterbium, scandium, barium, tin, iron, and bismuth. The high pressure barium transition was found at 137 kbars and the tin transition at 107 kbars. These values are in fair agreement with data of others who reported the transition of barium of 144 kbars and that of tin at 113–115 kbars. (auth)

42070 CONDUCTION OF HEAT IN LANTHANUM COBALTATE $LaCoO_3$. P. Gerthsen and F. Kettel (Philips Zentrallaboratorium GmbH Laboratorium, Aachen). Phys. Chem. Solids, 25: 1023-9(Sept. 1964). (In German)

An account is given of thermal conductivity measurements of semiconducting $LaCoO_3$ and $NdCoO_3$. At low temperatures the heat conductivity may be explained by lattice conductivity. At higher temperatures there appears an additional component of heat conductivity, which may be explained neither by an electronic component nor by radiation. Possible heat transport by excitons is discussed. (auth)

42071 DEDUCTION OF THE INTERATOMIC POTENTIAL IN METALS FROM ENERGETIC ION RANGES. D. P. Corkhill and G. Carter (Univ. of Liverpool). Phys. Letters, 12: 93-5(Sept. 15, 1964).

Expressions are found relating total path length, mean-square range, average projected path, mean free path, and other range parameters of ion or atom beams incident on metallic targets whose atoms have the same mass as the beam atoms. Equations are found relating experimentally observed values of these range parameters with the atomic potentials and atomic separations in the target metal. Values are given for Cu, Ag, and Au. (T.F.H.)

42072 THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF TERBIUM BETWEEN 5 AND 300°K. Sigurds Arajs and R. V. Colvin (United States Steel Corp., Monroeville, Penna.). Phys. Rev., 136: A439-41(Oct. 19, 1964).

The thermal conductivity λ of polycrystalline terbium was studied as a function of temperature T between 5 and 300°K. The λ-versus-T curve exhibits a maximum of 0.205 W cm^{-1} $°K^{-1}$ at 23°K. The antiferromagnetic-paramagnetic transition, T_{A-P}, causes an anomaly in the thermal conductivity at about 225°K. The ferromagnetic-antiferromagnetic transformation, T_{F-A}, because of the narrow antiferromagnetic region, is not observable from the λ versus-T curve. According to the electric resistivity data, T_{F-A} = 219 ± 1°K and T_{A-P} = 230 ± 1°K. The Lorentz function, calculated from the measured thermal conductivity and electric resistivity values on the same sample, indicates that heat is transported mainly by electrons, with possible additional transport by phonons and magnons. The intrinsic electric resistivity between 5 and 20°K is proportional to $T^{4.19\pm0.06}$. (auth)

42073 MEAN-SQUARE DISPLACEMENT OF DILUTE IRON IMPURITY ATOMS IN HIGH-PURITY BERYLLIUM AND COPPER. R. M. Housley (Univ. of Washington, Seattle), J. G. Dash, and R. H. Nussbaum. Phys. Rev., 136: A464-6(Oct. 19, 1964).

Absolute values of the Mössbauer fraction f of zero-phonon gamma rays from dilute ^{57}Cd in Be and Cu were obtained for several temperatures between liquid helium and room temperature using the technique of the black absorber. For Be at 297°K, f = 0.81; for Cu at 297°K, f = 0.71. Systematic errors are estimated to be less than 2%. The Mössbauer spectrum of Be shows a quadrupole splitting ΔE = 0.56 ± 0.03 mm/sec and a chemical shift $\delta = -0.11 \pm 0.03$ mm/sec with respect to an Fe absorber. (auth)

42074 ISOTOPE EFFECT IN SELF-DIFFUSION IN PALLADIUM. N. L. Peterson (Argonne National Lab., Ill.). Phys. Rev., 136: A568-74(Oct. 19, 1964).

The diffusion of ^{103}Pd in single crystals of palladium was measured over the temperature range of 1050–1500°C by the tracer-sectioning technique. The results are $D = 0.205^{+0.05}_{-0.04} \exp[-(63600 \pm 650)/RT]$ cm^2/sec. Four measurements of the isotope effect for diffusion of ^{103}Pd and ^{112}Pd in each of four single crystals of palladium were made between 1450 and 1500°C. The measured isotope effect E_β as defined by the equation $E_\beta = (1 - D_\beta/D_\alpha)/[1 - (m_\alpha/m_\beta)^{1/2}]$, where D_β/D_α and m_α/m_β are the ratios of the diffusion coefficients and masses of the two isotopes α and β was found to be 0.8134 ± 0.0424. This value is consistent only with diffusion by the vacancy mechanism, and indicates that the translational kinetic energy of the activated state in the jump direction is possessed entirely by the jumping atom as it crosses the saddle point. (auth)

42075 THERMAL CONDUCTIVITY OF PYROLYTIC GRAPHITE AT LOW TEMPERATURES. I. TURBOSTRATIC STRUCTURES. C. A. Klein and M. G. Holland (Raytheon Corp., Waltham, Mass.). Phys. Rev., 136: A575-7(Oct. 19, 1964).

The thermal conductivity along ($K_{\parallel}$) and across ($K_{\perp}$) the layer planes of 5 specimens of pyrolytic graphite (PG) in their as-deposited condition was investigated at temperatures ranging from 1.7 to 300°K. In both directions the conductivity increases with deposition temperature; the $K_{\parallel}/K_{\perp}$ ratio, however, remains close to 3 in the liquid-helium region and rises rapidly to about 125 at 300°K. In part, these anisotropies are presumed to reflect a situation in which only a fraction of the deposit permits regular heat flow perpendicular to the deposition surface. Above 100°K the thermal conductivity measured in this direction is almost temperature-independent ($K_{\perp} \approx 2 \times 10^{-2}$ W $cm^{-1}°K^{-1}$), while below 20°K it is nearly proportional to $T^{2.3}$, in accordance with the lattice specific heat C_L. At these temperatures the thermal resistance arises from boundary scattering, and judging from x-ray evidence the phonon mean free path may be taken as isotropic. Turbostratic stacking affects the shearing elastic constant quite drastically; with $c_{44} = 0.702 \times 10^{10}$ dyn/cm^2 as suggested by Komatsu for lampblack-base graphite, a theoretical analysis confirms that below 4°K major contributors to $K_{\perp}$ are out-of-plane modes, and, therefore, $K_{\perp}$ should exhibit the same temperature dependence as C_L. By contrast, along layer planes the thermal conductance has an anomalous temperature dependence ($\propto T^{2.5}$ from about 10 to 80°K), which reflects mainly the dispersive nature of bond-bending vibrations in graphite. At still lower temperatures $K_{\parallel}$ involves electronc contributions K_E and can be expressed as a sum of two terms $AT + BT^n$, where $n \approx 2.6$ as predicted from a long-wavelength treatment of the effective phonon velocity, which shows that in-plane modes are seriously enhanced relative to the part they play in C_L. Plots of $K_{\parallel}/T$ versus T^{n-1} for $T \lesssim 4$°K yield straight lines with intercepts A and slopes B that correlate closely with the deposition temperature. The slopes are direct measures of the phonon mean free paths (600 to 1200 Å, which corresponds to the polygonal zones of the wrinkled-sheet structure), and illustrate the gradual improvement in preferred orientation as the deposition temperature covers the range 1700 to 2300°C. In conjunction with measurements of the electric resistivity parallel to the deposition surface, the intercepts point to Lorenz numbers $K_{E\rho\parallel}/T$ of the order of 3 to 4 × 10^{-8} $(v/°K)^2$. Within the framework of a simple two-band-model description of graphite, there is strong evidence for a bipolar term in the electronic thermal conductivity of turbostratic PG, which indicates that these Lorenz numbers may not be inconsistent. (auth)

42076 LONG-RANGE MAGNETIC COUPLING IN METALS. B. Dreyfus, R. Maynard, and A. Quattropani (Centre de Recherches sur les Tres Basses Températures, Grenoble, France and CEN, Grenoble, France). Phys. Rev. Letters, 13: 342a-3a(Sept. 14, 1964).

An oscillatory exchange coupling exists between two magnetic ions imbedded in a normal metal. It is shown that the existence of bound electronic states can lead to non-oscillatory couplings. This result is derived by boundary-value techniques. The values obtained for the coupling strengths are independent of temperature and mean-free-path effects. (T.F.H.)

42077 NEW DE HAAS–VAN ALPHEN FREQUENCIES IN BERYLLIUM CAUSED BY MAGNETIC INTERACTION. R. D. Plummer and W. L. Gordon (Case Inst. of Tech., Cleveland). Phys. Rev. Letters, 13: 432-4(Oct. 5, 1964).

Strong distortion in a set of de Haas-van Alphen oscillations in Be was observed, together with the generation of a low-frequency oscillation by the envelope modulation of this set. (D.C.W.)

42078 CONSTITUTION DIAGRAM OF NIOBIUM–COBALT ALLOY. A. K. Shurin and G. P. Dmitrieva. Sb. Nauchn. Rabot Inst. Metallofiz., Akad. Nauk Ukr. SSR, No. 18, 175-7(1964). (In Russian)

The phase diagram of the Nb–Co alloy was studied previously only in thre 0 to 33.3 at. % Nb region; the system possesses a eutectic point at 1235°C, at which a liquid with 14.5 at. % Nb, a saturated solid solution of Nb in Co at 5 at. % Nb, and the intermetallic compound Nb_2Co_5 are present. In order to verify the existence of the previously reported $NbCo_2$ phase, isomorphic with MgN_2, 30 alloys, with compositions ranging from 14.4 to 99.2 at. % Nb were prepared by melting together electrolytic Co and pure Nb in a watercooled arc furnace with W electrodes, under Ar atmosphere and annealing three specimens under Ar or in vacuum. The phase diagram of the system was determined by differential thermal analysis. The eutectic equilibrium point × liquid $\rightleftharpoons \alpha + NbCo_3$ was found to lie at 1210 ± 10°C. The concentration region within which the intermetallic compound $NbCo_3$ is homogeneous at 700 to 1100°C amounted to 5 at. %, ranging from 28 to 33 at. %, with a melting point at 1450 ± 10°C. X-ray diffraction studies of the alloys containing 24, 25.6, and 27.5 at. % Nb showed that they contained only the α-phase and $NbCo_2$. The β-intermetallic compound is formed during the crystallization by the peritectic reaction liquid + $NbCo_2 \rightleftharpoons \beta$ at 1440 ± 10°C and is decomposed at 1225 ± 20°C by the eutectoid reaction $\beta \rightleftharpoons NbCo_2 + NbCo$. The Nb–Co phase diagram is similar to that of the Nb–Fe system, except for the presence of the 90 at. % Nu μ-phase in the latter. The binary (NbCo + γ) alloys, annealed at 700, 1000, and 1250°C were found to contain only the NbCo and γ-phases. (TTT)

42079 THERMAL CONDUCTIVITY OF Sm, Pr, AND THEIR MONOCHALCOGENIDES. E. D. Devyatkova, V. P. Zhuze, A. V. Golubkov, V. M. Sergeeva, and I. A. Smirnov (Semiconductor Inst., Leningrad). Soviet Phys.-Solid State (English Transl.), 6: 343-6(Aug. 1964). Translated from Fiz. Tverd. Tela, 6: 430-5(Feb. 1964).

The thermal conductivities of Sm, Pr, PrS, PrSe, PrTe, and SmS were measured in the interval 80 to 460°K. It was found that in these substances an appreciable part of the total thermal conductivity is lattice thermal conductivity. The temperature dependence of lattice thermal conductivity is explained by the presence of two mechanisms of scattering: that of phonons by phonons, and that of phonons by conductivity electrons. (auth)

42080 VACANCY FORMATION IN MOLYBDENUM. Ya. A. Kraftmakher (Inst. for Heat Physics, Novosibirsk, SSR). Soviet Phys.-Solid State (English Transl.), 6: 396-8 (Aug. 1964). Translated from Fiz. Tverd. Tela, 6: 503-5 (Feb. 1964).

The formation of vacancies in molybdenum was investigated by the direct measurement of the specific heat at high temperatures (1300 to 2500°K). The vacancy concentration in molybdenum was found to be described by the expression $C = 300 \exp(-2.24/kT)$, approaching 4.3% at the melting point. (auth)

42081 SPIN-LATTICE RELAXATION OF F-CENTERS IN ALKALI-HALIDE CRYSTALS. A. M. Vasil'ev (All-Union Scientific Research Inst. on Current Sources, Moscow). Soviet Phys.-Solid State (English Transl.), 6: 485-9 (Aug. 1964). Translated from Fiz. Tverd. Tela, 6: 619-24 (Feb. 1964).

The features of the relaxation and saturation of F-center electron spins were examined on the basis of a contact interaction between the electron and the nuclei surrounding the F-center vacancy. Previously determined experimental data are discussed, and a method is proposed for distinguishing experimentally between contact relaxation and other types of relaxation. (auth)

42082 EFFECT OF RADIATION FROM RADIOISOTOPES ON THE CHARACTERISTICS OF SILICON CARBIDE p–n JUNCTIONS. T. E. Kharlamova and D. A. Tairova (Ul'yanova-Lenin Electrotechnical Inst., Leningrad). Soviet Phys.-Solid State (English Transl.), 6: 503-4 (Aug. 1964). Translated from Fiz. Tverd. Tela, 6: 642-4 (Feb. 1964).

Single crystals of SiC were irradiated and afterwards p–n junctions were constructed on them. The characteristics of these junctions were then compared with those of p–n junctions made from unirradiated material. Irradiation dose variations in the range 3000 and 28000 R did not have a significant effect on the quantitative changes in the SiC p–n junction characteristics. All of the SiC junctions irradiated by γ rays and β particles exhibited a definite pattern in the changes of the current-voltage characteristics: the reverse conductance increased and the forward conductance decreased. A mixed γ ray and neutron source did not cause any change in the current-voltage characteristics. However, the mixed radiation did lead to the appearance of a junction photoeffect. (P.C.H.)

42083 ON LANTHANUM POLYMORPHISM. A. A. Eliseev, E. I. Yarembash, E. S. Vigileva, L. I. Antonova, and A. V. Zachatskaya (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 9: 1032-7(May 1964). (In Russian)

Microstructure, x ray, and differential thermal analyses were made of two La specimens with 0.7 to 0.2% impurities. Under normal conditions the specimens had α and β modifications with lattice parameters for α-La; a = 3.755 ± 0.005 Å, c = 12024 Å and β-La; a = 5291 ± 0.005 Å. An abnormal compression of La at 325° was related to a reduced β-La lattice. At 200 to 300°C the contraction of the α-La lattice parameter along the axis c is considerably smaller. The coefficient for β-La linear expansion at 300 to 330° is -400×10^{-6} degree^{-1}. The α to β transformation takes place at 400°C with β prevailing at temperatures above 400°. An enantiotropic β to γ transformation takes place at 850°C. The melting point of the specimens was 900 ± 3°C. (R.V.J.)

42084 SYSTEM Ta–Ta_2O_5. L. B. Dubrovskaya, G. P. Shveikin, and P. V. Gel'd. Zh. Neorgan. Khim., 9: 1182-6(May 1964). (In Russian)

X-ray-diffraction analysis showed that no intermediate oxides are formed in Ta–Ta_2O_5 at 1050°C and above. The Ta–O system is described by a simple eutectic melting diagram with the eutectic point near TaO. Annealing at 1050° for 500 hr followed by water quenching did not alter the phase structure. (R.V.J.)

42085 X-RAY ANALYSIS OF ZIRCON FORMATION IN SiO_2–ZrO_2–V_2O_5 SYSTEM. A. S. Bystrikov and B. S. Cherepanov (State Research Inst. of Construction Ceramics, USSR). Zh. Neorgan. Khim., 9: 1197-1200(May 1964). (In Russian)

A high-temperature x-ray analysis using a specially designed diffractometer produced some new data on reactions in SiO_2–ZrO_2–V_2O_5. Zircon ($ZrSiO_4$) formation during heating of equimolar mixtures of SiO_2 and ZrO_2 was investigated, and the influence of V_2O_5 on the reaction kinetics was determined. (R.V.J.)

42086 THE PALLADIUM–TANTALUM SYSTEM. E. M. Savitskii, V. P. Polyakova, M. A. Tylkina, and G. S. Burkhanov. Zh. Neorgan. Khim., 9: 1645-9(July 1964). (In Russian)

A constitution diagram constructed for Pd–Ta exhibited a complex structure forming four metallic compounds and limited solid solutions of diffused metals. The melting point of the metals differs almost 1500°C (with the Pd melting point at 1552°C and Ta at 2999°C). (R.V.J.)

42087 THE HAFNIUM–NIOBIUM SYSTEM. M. A. Tylkina, I. A. Tsyganova, and E. M. Savitskii. Zh. Neorgan. Khim., 9: 1650-2(July 1964). (In Russian)

The phase diagram of the Hf–Nb system shows a continuous series of solid solutions of niobium with β-hafnium, a limited solubility with α-hafnium, and a eutectoid decomposition of the β-solid solution. In the cast state, Hf–Nb alloys have a polyhedral structure. Dendritic liquation, usually observed in cast alloys, is lacking, indicating a small temperature interval of crystallization. The phase composition of alloys in the cast state, which may be regarded as the result of quenching from high temperatures by rapid cooling at the bottom of the arc furnace, is plotted on the 2000° isotherm. Alloying of Hf with Nb is accompanied by a drop in the polymorphic transformation temperature to 820 ± 20° at which β-Hf solid solution undergoes a eutectoid decomposition according to the reaction β-Hf $\rightleftharpoons$ α-Hf + β-Nb. The solubility of Nb in Hf at this temperature does not exceed 3 wt % (6 at.%). The solubility of Hf in Nb at 820° does not exceed 10 wt % (6 at.%) and increases somewhat at 1500°. (R.V.J.)

42088 THE VANADIUM–NIOBIUM–SILICON SYSTEM. V. V. Baron, Yu. V. Efimov, E. M. Savitskii, and E. I. Gladyshevskii. Zh. Neorgan. Khim., 9: 1653-7(July 1964). (In Russian)

A constitution diagram was constructed for the V–Nb–Si system containing 50% Si. At 800°C the solubility of Nb in the solid solution having a V_5Si_3 base is 45% and the solubility of V in α-Nb_5Si_3 base solution is ~7%. The solubility of Nb in V_3Si at temperatures close to the melting point is ~30%. The Nb_4Si compound is practically insoluble in V and does not enter into equilibrium in ternary alloys containing 5% V or more. The solubility of Si in (V,Nb) solid solutions does not exceed 1 at.% at 800°C. (R.V.J.)

42089 DISTRIBUTION OF CERTAIN RARE EARTH ELEMENTS BETWEEN TWO MELTED METALS. A. P. Bayanov and V. V. Serebrennikov. Zh. Neorgan. Khim., 9: 1658-61(July 1964). (In Russian)

The distribution of La, Ce, Pr, Nd, Sm, and Y between Zn and Pb at 500°C and Ce in Al–Cd, Al–Pb, Al–Bi, and Zn–Pb at 700°C was studied. The distribution coefficients of La, Ce, Pr, Nd, Sm, and Y between molten zinc and lead vary from 2.8×10^3 to 6×10^3 at 500°C. The distribution coefficients of Ce in the molten paired metals follow a weakening transition from Zn, Bi > Al > Pb ≥ Cd. (R.V.J.)

42090 PHASE EQUILIBRIUM DIAGRAM FOR Ti–Al–(Mo : V = 1 : 1) SYSTEM. Chih-ming Ko, I. I. Kornilov, and E. N. Pylaeva. Zh. Neorgan. Khim., 9: 1662-8(July 1964). (In Russian)

A phase diagram for the Ti–Al–(Mo : V = 1 : 1) system with up to 50 wt % Al, Mo, and V was constructed. Isothermal cross sections were plotted for 1100, 800 and 600°C. The phase equilibria and the phase regions were found to be α, β, γ, $\alpha + \beta$, $\alpha + \gamma$, $\beta + \gamma$, and $\alpha + \beta + \gamma$. Diagrams of the composition–hardness and composition–electric conductivity were constructed for Ti–Al–(Mo : V = 1 : 1) alloys. (R.V.J.)

42091 THE W–Nb–Si SYSTEM. N. V. Dokukina, E. I. Gladyshevskii, and F. I. Shamrai. Zh. Neorgan. Khim., 9: 1905-10(Aug. 1964). (In Russian)

A W–Nb–Si phase diagram was constructed in order to determine the solid solution boundary and to verify the distribution and equilibrium of phases. The phase equilibrium distribution of the ternary W–Nb–Si system is similar to the transition metals of the IV to VI groups. (R.V.J.)

42092 THE YTTRIUM–ERBIUM AND YTTRIUM–SCANDIUM ALLOYS. I. A. Markova, V. F. Terekhova, and E. M. Savitskii. Zh. Neorgan. Khim., 9: 2034-6(Aug. 1964). (In Russian)

Constitution diagrams were constructed for Y–Er and Y–Sc alloys. Microstructure, thermal and x-ray analyses, and hardness measurements showed that Y–Er formed continuous series of solid solutions with a hexagonal densely packed lattice. The Y–Sc alloy also formed continuous solid solutions of isomorphous component modifications. (R.V.J.)

42093 GADOLINIUM ALLOYS WITH TERBIUM AND ERBIUM. I. V. Burov, V. F. Terekhova, and E. M. Savitskii. Zh. Neorgan. Khim., 9: 2036-8(Aug. 1964). (In Russian)

Microstructure, thermal and x-ray analyses, and measurements of hardness, electric conductivity, lattice parameters, and Curie point were used for plotting constitution diagrams for Gd–Tb and Gd–Er. The constitution diagrams of both alloys are of the same type and form continuous solid solutions between isomorphous metal modifications. Preliminary studies of the magnetic properties below the Curie point indicated an abnormal temperature dependence on magnetization. (R.V.J.)

42094 MICROSTRAIN STUDIES IN IRON AND MOLYBDENUM BETWEEN 5 AND 298°K. Ram Kossowsky. Thesis, Philadelphia, Univ. of Pennsylvania, 1963. 209p.

The nature of the basic mechanism that controls flow and yield in bcc metals was studied by analyzing the dependence of the initial yield on temperature, strain history, and purity. Seven specimens of iron and ten specimens of molybdenum of three different purities were tested in tension on an Instron testing machine. The load vs extension curves were plotted on a Moseley X-Y Recorder. Tests were conducted at temperatures between 298° and 5°K. The characteristics of the following parameters were investigated: 1) the elastic limit, which is the stress above which a hysteresis loop is first observed upon loading and unloading, 2) the anelastic limit, which is the stress at which a permanent strain can be first detected, 3) the frictional stress, which is defined as half the slope in a plot of loops area as a function of loops width. The results indicated an almost identical behavior of the iron and molybdenum. The elastic and the frictional stress were independent on prestrain and strain rate. The temperature dependence was the same for all purities down to 77°K. At 5°K an increase in the temperature dependence of the elastic limit and the frictional stress was observed for the less pure specimens. The anelastic limit had a temperature dependence that was the same for the different purities, but the athermal part showed a marked decrease with increasing purity. The anelastic limit was independent of prestraining strain rate, but exhibited a significant dependence upon prestraining temperature and strain rate. (Dissertation Abstr., 25: No. 1, 1964)

42095 THE EFFECTS OF VALENCE AND SIZE UPON THE ALLOTROPIC TRANSFORMATION TEMPERATURES

OF ZIRCONIUM AND THORIUM BASE BINARY ALLOYS. James Cheng Uy. Thesis, Troy, N. Y., Rensselaer Polytechnic Inst., 1963. 59p.

The effects of valence and size of alloying elements upon the allotropic transformation temperatures of zirconium and thorium were investigated utilizing existing data in the literature for the allotropic phase boundaries of zirconium- and thorium-base binary systems. Partial phase diagrams of certain rare-earth solutes in zirconium and thorium solvents were determined experimentally by metallographic and electrical resistivity techniques. The above evaluations were carried out by means of an intermediate thermodynamic parameter, which is the difference in the differential heats of mixing between the allotropes. The relationship between this parameter and the allotropic phase boundaries is shown; subsequently, the effects of the relative valence and size factors upon this parameter are presented. It was found that in these binary systems the relative Pauling valence bears a strong quantitative correlation with the allotropic phase boundaries, and that, at small values of this relative valence factor, the effect of the size factor can be seen to play a significant, though secondary, role. (Dissertation Abstr., 25: No. 1, 1964).

42096 JOINT INTERNATIONAL CONFERENCE ON CREEP, NEW YORK, 25TH–29TH AUGUST 1963 AND LONDON, 30TH SEPTEMBER–4TH OCTOBER 1963. BOOK (I). SESSION 1: FUNDAMENTAL CONSIDERATIONS, INCLUDING METALLURGICAL STRUCTURE; ATOMIC LATTICE; DISLOCATIONS. London, The Institution of Mechanical Engineers, [1964]. 121p.

Eleven articles are included on: creep deformation of polycrystalline Mg; high temperature mechanical properties of superalloys; effects of prior creep on the tensile properties of cold-worked unalloyed Al; strain-time, rate-stress, and rate-temperature relations during large deformations in creep; blunting of cracks by surface tension; effects of N, B, Zr, and V on microstructure, tensile, and creep-rupture properties of Cr–Ni–Mn–Mo stainless steel; relation between microstructure and creep resistance in Ni base alloys; electron microscopic studies on the creep deformation process of unplasticized polyvinyl chloride; creep behavior, structural changes, and cracks in creep rupture tests lasting several years; influence of boron in austenitic alloys; and factors governing the creep properties in large diameter 1% Cr–Mo–V rotor forgings. (P.C.H.)

42097 JOINT INTERNATIONAL CONFERENCE ON CREEP, NEW YORK, 25TH–29TH AUGUST 1963 AND LONDON, 30TH SEPTEMBER–4TH OCTOBER 1963. BOOK (2). SESSION 2: PLASTICITY THEORY—THEORETICAL AND EXPERIMENTAL STUDIES UNDER UNIAXIAL AND COMBINED STRESSES. SESSION 3: THERMAL OR MECHANICAL CYCLING, WITH OR WITHOUT CREEP. London, The Institution of Mechanical Engineers, [1964]. 227p.

Twenty-seven articles are included on: small-deflection creep buckling; multiaxial creep in tubes; multiaxial creep-strain complex-stress/time relations; creep instability of flat plates; cyclic strain under complex loading; stress concentration in steady creep; creep and relaxation of heavy walled cylinders; plasticity theory of creep; stress creep experiments on viscoelastic material; creep torsion of prismatic bars; combined-stress creep under changing loads; equation of state of creep; transient creep of materials; thermal fatigue resistance; cyclic stress-induced creep; interaction between creep and fatigue; accentuation of tensile creep; cracking in casings; thermal shock behavior of steel; creep under repeated stress reversals; strain-fatigue properties of steels; fracture and deformation of metals; cyclic strain aging and fatigue of steel; interrelation of cyclic and monotonic creep rupture; effects of temperature and load cycling on creep resistance and microstructure of steels; low-cycle high-strain fatigue behavior of steel; and creep-resistance and low-cycle fatigue of plastics. (P.C.H.)

42098 JOINT INTERNATIONAL CONFERENCE ON CREEP, NEW YORK, 25TH–29TH AUGUST 1963 AND LONDON, 30TH SEPTEMBER–4TH OCTOBER 1963. BOOK (3). SESSION 4: CRITERIA FOR DESIGN—NOTCH EFFECTS; TUBE BURSTING; PROOF STRESS. CREEP OF GRAPHITE. London, The Institution of Mechanical Engineers, [1964]. 94p.

Eleven articles are included on: creep-rupture properties of tubes; notch rupture behavior of steels; stress concentration and size effects in steel; short-time creep response of Al–V–Ti alloy; high temperature yield and proof stress of carbon steels; deformation and creep mechanisms in graphite; stress criteria for designing economical boilers; design stresses for boilers and pressure vessels; qualifying of pressure piping materials for stress allowance; design of high-temperature steam pipes; and service experiences at 1050 and 1100°F of steel piping. (P.C.H.)

42099 JOINT INTERNATIONAL CONFERENCE ON CREEP, NEW YORK, 25TH–29TH AUGUST 1963 AND LONDON, 30TH SEPTEMBER–4TH OCTOBER 1963. BOOK (4). SESSION 5: CREEP AND RUPTURE DATA FOR PARTICULAR MATERIALS. SESSION 6: APPLICATION, INTERPRETATION AND EXTRAPOLATION OF CREEP AND RUPTURE DATA. RELAXATION. London, The Institution of Mechanical Engineers, [1964]. 221p.

Twenty-two articles are included on: creep-rupture tests on furnace tube material; high temperature rupture properties of steels; evaluation of creep tests; creep-rupture strength of steel; creep properties of Ni base alloys; high-temperature properties of steels; ferritic alloyed steels; log stress/log time curve of long time creep-rupture tests; properties and welding of steel forgings; creep and stress rupture properties of steels; stress-relaxation properties of bolt steels; relation between creep rate and microstructure; extrapolation of creep-rupture properties; creep-rupture strength of steels; analyzing and extrapolating stress-rupture data; high-temperature strength and ductility criteria; an isothermal tensile stress-relaxation apparatus; steels in steam turbines; extrapolation of creep and stress-rupture data; and creep tests by means of parametric formulas. (P.C.H.)

42100 JOINT INTERNATIONAL CONFERENCE ON CREEP, NEW YORK, 25TH–29TH AUGUST 1963 AND LONDON, 30TH SEPTEMBER–4TH OCTOBER 1963. BOOK (5). SFSSION 7: CORRELATION OF SERVICE DATA WITH LABORATORY TESTS. ENVIRONMENTAL EFFECTS. London, The Institution of Mechanical Engineers, [1964]. 78p.

Eight articles are included on: power generating steam plant; metallurgical experience with the Eddystone 5000 lb/in.^{2} 1200°F unit No. 1; creep resistance alloys for long-life service; calibration and standardization of creep-rupture test methods; service testing at elevated temperature; creep-rupture of nickel of two purities in controlled environments; steel and alloy superheater tubes in power boiler service; and creep phenomenon as it affects steam turbine rotor life. (P.C.H.)

42101 COMPOSITE HEAT-INSULATING MATERIAL HAVING A VERY LOW THERMAL CONDUCTIVITY AT ELEVATED TEMPERATURES AND POSSESSING A GOOD DEFORMABILITY. (to Commissariat a l'Energie Atomique). French Patent 1,207,197. Aug. 31, 1959. Filed Aug. 30, 1958.

A flexible, heat-insulating material was developed, which consists of an assembly of separate, superposed metallic layers (Al, Ni) not exceeding 0.2 mm in thickness, each layer having on at least one face thereof a compact film of a metal oxide adhering to the metal. The films can be prepared by prior anodic oxidation of the separate layers. The Al-based material may be applied in nuclear reactors, e.g., for wrapping up tubes. The material retained its low conductivity at temperatures over 500°C and sometimes up to 1000°C. (NPO)

42102 STRUCTURE OF THE EXTREMITIES OF NUCLEAR FUEL ELEMENTS THAT ARE VERTICALLY STACKED UP. (to Commissariat a l'Energie Atomique). French Patent 1,217,058. Dec. 7, 1959. Filed Nov. 18, 1958.

In order to improve the creep behavior of the end caps of fuel rods that are applied in vertical fuel channels, the caps were reinforced with an annular or cup-shaped organ of a creep resistant metal (stainless steel, Be, Mg–Th, or SAP). As an additional measure thermally insulating disks can be interposed between the cap and the fuel. (NPO)

42103 METALLURGICAL PROCESS APPLIED TO METALLIC BERYLLIUM. (to United Kingdom Atomic Energy Authority). French Patent 1,287,059. Jan. 29, 1962. Priority date Apr. 4, 1960, Great Britain.

The ductility of cast beryllium was improved by heating cast beryllium with an iron content of between 0.12 and 0.2 wt % at such a temperature over 550°C that the beryllium is in the zone of coalescence. The temperature was a function of the iron content. The time of heating was a function of the temperature. These functions are depicted in graphs. (NPO)

42104 URANIUM ALLOYS WITH LOW CONTENT OF ADDITION ELEMENTS AND THEIR METHOD OF PREPARATION. (to Commissariat a l'Energie Atomique). French Patent 1,303,034. July 30, 1962. Filed July 21, 1961.

The preparation of fine grained, homogeneous uranium fuel alloys having an increased resistance towards creep, traction, and thermal cycling is described. Alloys containing either 0.06 to 0.15 wt % Si, 0.08 to 0.12 wt % Cr, or 0.05 to 0.1 wt % Al + 0.02 to 0.03 wt % Fe + 0.01 to 0.05 wt % Cr + 0.01 to 0.05 wt % Si were annealed at 710 to 760°C for 5 to 15 min, quenched at 500 to 550°C for 5 to 10 min in a salt bath, and finally quenched in water. Alloys containing either 0.02 to 0.05 wt % Fe, Cr, or Si, 0.02 to 0.05 wt % Fe or Cr + 0.05 to 0.12 wt % Al, 0.01 to 0.05 wt % Si + 0.05 to 0.12 wt % Al or 0.05 to 0.1 wt % Mo, 0.02 to 0.03 wt % Fe + 0.01 to 0.02 wt % Si were annealed in the same way, but then directly quenched in water. (NPO)

42105 METHOD FOR IMPROVING THE PROPERTIES OF SINTERED ALUMINIUM PARTICULARLY FOR NUCLEAR APPLICATIONS. (to Societa per l'Esercizio dell' Instituto Sperimentale dei Metalli Leggeri). French Patent 1,320,365. Jan. 28, 1963. Priority date May 30, 1961, Italy.

SAP fuel element jackets have the disadvantage of (micro) fissuring and blistering, due to the hydrogen content of the material. The hydrogen content can be decreased to 2 to 5 ppm by degassing the compacted Al powder, having an Al_2O_3 content up to 20%, at 550 to 600°C and 10^{-4} to 10^{-5} mm Hg for 10 to 30 hr prior to sintering. (NPO)

42106 IMPROVEMENTS IN NUCLEAR FUELS. (to United Kingdom Atomic Energy Authority). French Patent 1,322,595. Feb. 18, 1963. Priority date May 25, 1961, Great Britain.

A nuclear fuel was developed that consists of a dispersion of UC in an Fe or Cr matrix. The melting point of the composition is between 1000 and 1600°C and the Fe or Cr content is over 40 or 30 to 60 wt % respectively. Preferred compositions for fast reactors are 14 to 21.5 at.% U, 12 to 20 at.% C, and the balance Fe or 15 to 27 at.% U, 12 to 25 at.% C, and the balance Cr. Up to 30 wt % UC can be replaced by PuC. To improve the oxidation and mechanical resistance minor amounts of Si, Mo, W, and/or Ni can be added. (NPO)

Radiation Effects

Refer also to abstract 43048.

42107 (AD-605302) FISSION FRAGMENT DAMAGE IN URANIUM-DOPED GERMANIUM. Annual Technical Report. Robert E. Ogilvie (Massachusetts Inst. of Tech., Cambridge). July 1, 1964. Contract Nonr 1841(84). 24p.

A theoretical model for the spatial distribution of fission fragment damage in bulk crystals of copper and germanium has been developed. Calculations of the energy distribution of primary knock-on atoms and of the range and energy loss of such atoms in the lattice are combined to determine the radial Frenkel defect concentration in a cylindrical fission spike. The radial strain field associated with such a defect concentration is also calculated and applied to the theory of diffraction contrast of fission tracks in the electron microscope. Several experimental studies of fission damage in bulk materials are discussed in the light of the proposed model. An experimental investigation of fission fragment damage has been made in n-type germanium. Single crystals doped with uranium-235 were grown by the Czochralski method. Segregation effects and dislocation patterns were observed by anomalous x-ray transmission microscopy. Fission track registration in mica detectors was used to determine the very low uranium concentrations. The effect of fission fragment damage on electron mobility was studied by measuring electric resistivity and Hall effect from 80–400°K. A small decrease in mobility with increasing fission density was found. The experimental results are explained on the basis of a cylindrical space charge theory which permits a determination of the effective radius of a fission spike in germanium. A value of $r_1 = 154 \pm 40$ Å has been obtained, which compares very well with a value of 165 Å as calculated from the proposed fission damage model. (auth)

42108 (AECL-1986) THE EFFECT OF NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF HYDRIDED ZIRCONIUM ALLOYS. A. Sawatzky (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1964. 16p.

Described are the effects of neutron irradiation on the mechanical properties of zirconium–2.5 wt % niobium and cold worked Zircaloy-2 having hydrogen contents from zero to 300 ppm. Specimens were irradiated at 280°C to an integrated neutron flux of 1.0×10^{21} n/cm^2 with energies >500 ev. The tensile strength of both alloys increased with irradiation. However, they were little affected by hydrogen concentrations over the range investigated. The impact strength was decreased by irradiation and to a lesser extent by hydrogen. (auth)

42109 (ANL-6538) THE IRRADIATION OF ALUMINUM ALLOY-CLAD THORIA–URANIA PELLETS. Final Report–Metallurgy Program 6.2.3. L. A. Neimark and J. H. Kittel (Argonne National Lab., Ill.). June 1964. Contract W-31-109-eng-38. 37p.

Specimens consisting of ThO_2–UO_2 pellets lead-bonded to extruded Al–1 wt % Ni alloy cladding were irradiated to maximum burnups of 33,200 Mwd/t of oxide and to peak heat ratings of $\int_{T_s}^{T_0} k d\theta = 63$ w/cm. The specimens were prototype BORAX-V fuel plates. The ThO_2–UO_2 solid solutions were formed by air-firing cold-pressed mixtures of ThO_2 and U_3O_8 to a final oxygen-to-metal atom ratio of about 2.05 to 1. Fuel compositions irradiated were 6.36, 12.7, and 25.6 wt % UO_2 in ThO_2. Two specimen failures were attributed to fuel thermal expansion in areas of thin-walled cladding. The hyperstoichiometry of the fuel with respect to oxygen was believed to have caused a lower fuel thermal conductivity and abnormally large amounts of recrystallization, grain growth, and fission gas release. Fission gas release ranged from 4.6 to 81.2% of the theoretical gas generated. (auth)

42110 (FGT-2622) [EFFECTS OF IRRADIATION UNDER STATIC AND DYNAMIC CONDITIONS ON LUBRICATING OIL GTO-790]. Period Covered: August 11, 1959–April 7, 1960. R. H. McDaniel (Convair, Fort Worth, Tex.). July 7, 1960. Contract AF33(600)-38946. 38). (AD-437238)

A dynamic pump loop system, was operated for 50 hr in a non-nuclear environment to establish base line data on the functional fluid which was GTO-790. The system was then subjected to operation in a nuclear environment. Dynamic and static oil samples were taken periodically to determine physical and chemical property changes of the test fluids. Average bulk oil temperature was 285°F. The irradiation run was terminated after 19.5 hrs. because of decreasing flash point values. The effects of simultaneous dynamic operation and irradiation on GTO-790 fluid did not appear to be synergistic. (auth)

42111 (NARF-63-18T) STUDY OF THE EFFECTS OF NUCLEAR RADIATION ON THE MECHANICAL PROPERTIES OF ACETAL RESINS DELRIN AND CELCON. E. G. Fritz (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Mar. 31, 1964. Contract AF33(657)-7201. 43p. (AD-603016; FZK-9-194)

Two commercial acetal resins (Delrin and Celcon) were exposed to reactor radiation at room temperature in air to five levels of absorbed dose: 3.07×10^8, 6.8×10^8, 1.53×10^9, 3.83×10^9, and 1.18×10^{10} ergs/gm(°C). The tensile strength of both resins was found to decrease rapidly with increasing dose: 50% of the original value is reached at about 0.3 gigaergs/gm(C) for Delrin and at about 0.75 gigaergs/gm(C) for Celcon. At about 1 gigaerg/gm(°C), both materials had virtually lost their mechanical usefulness. The Shore-D hardness of the two resins was found to decrease exponentially with dose. On the basis of weight-loss measurements, the G-values for formaldehyde formation were conservatively estimated to be 15.4 and 8.9 for Delrin and Celcon, respectively. Depolymerization appears to be the predominant mode of degradation. (autn)

42112 (RSIC-150(Vol.I)) SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I. ELASTOMERIC AND PLASTIC MATERIALS. N. J. Broadway, R. W. King, and S. Palinchak (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1964. Contract DA-01-021-AMC-203(Z). 100p. (AD-603364)

Results are presented of a literature survey on Space Environmental Effects upon Materials and Components. The major emphasis of this literature survey has been the effects of vacuum and space radiation on organic materials, and electronic and mechanical components and materials. This volume covers Elastomeric and Plastic Materials. (auth)

42113 (RSIC-150(Vol.I)(App.B)) SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I. ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX B. PLASTICS. (Army Missile Command, Redstone Arsenal, Ala.). Apr. 1, 1964. 86p. (AD-603366)

Tables and figures are given on the effects of space environment on various plastics. The plastics covered include Acrilan, fluorocarbon plastics, Teflon, Mylar, etc., and the properties studied include weight loss, physical properties, mechanical properties, friction, dielectric properties, etc. (D.L.C.)

42114 (RSIC-150(Vol.I)(App.C)) SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I. ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX C. COATINGS. (Army Missile Command, Redstone Arsenal, Ala.). Apr. 1, 1964. 61p. (AD-603367)

Tables and figures are given on the effects of space environment on various coating materials. Some of the coating materials investigated are paints, enamels, organic polymers, silicons, etc., and the properties studied include weight loss in vacuum, color changes, vacuum-thermal effects, etc. (D.L.C.)

42115 (RSIC-150(Vol.I)(App.D)) SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I. ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX D. STRUCTURAL ADHESIVES. (Army Missile Command, Redstone Arsenal, Ala.). Apr. 1, 1964. 38p. (AD-603368)

Tables and figures are given on the effects of space environment on the bonding properties and mechanical properties of various adhesives. Among the adhesives studied are epoxy, nylon, vinyl, etc. (D.L.C.)

42116 (RSIC-150(Vol.I)(App.F)) SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I. ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX F. LAMINATES. (Army Missile Command, Redstone Arsenal, Ala.). Apr. 1, 1964. 43p. (AD-603370)

Tables and figures are given on the effects of vacuum, temperature, and radiation on the weight and mechanical properties of various laminates. (D.L.C.)

42117 (RSIC-150(Vol.I)(App.G)) SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I. ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX G. POTTING COMPOUNDS. (Army Missile Command, Redstone Arsenal, Ala.). Apr. 1, 1964. 15p. (AD-603371)

Tables and one figure are given on the effects of vacuum, temperature, and radiation on the physical, electric, and mechanical properties of plastic potting compounds and encapsulating materials. Results of static and low-force dynamic tests are summarized. (D.L.C.)

42118 (RSIC-150(Vol.I)(App.H)) SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I. ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX H. SEALS, O-RINGS, AND GASKETS. (Army Missile Command, Redstone Arsenal, Ala.). Apr. 1, 1964. 21p. (AD-603384)

Tables and figures are presented for tests of various seals, O-rings, and gaskets. These tests include tests made on the effects of vacuum and radiation on the leakage and mechanical properties. (D.L.C.)

42119 (RSIC-150(Vol.I)(App.I)) SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I. ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX I. RADIATION AT CRYOGENIC TEMPERATURE. (Army Missile Command, Redstone Arsenal, Ala.). Apr. 1, 1964. 37p. (AD-603372)

Figures are given on the radiation effects on the mechanical properties of the following materials: Hexcel 1252, Metlbond 406, Kel-F-81, Stafoam AA 402, H-Film, Mylar-C, Conolon 506, Paraplex P-43, Skyspar A-423, and W-49-BC-12. (D.L.C.)

42120 (AEC-tr-6474) PHENOMENA OF RADIATION RELAXATION OF ELASTIC STRESSES IN MATERIALS. K. P. Dubrovin, L. D. Panteleev, and P. N. Platonov (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). (Translation). 1962. 13p.

Experiments in studying the relaxation of working stresses and microstresses in metals under the effect of neutron radiation are described. It is demonstrated that in both fissionable and non-fissionable materials the radiation causes a relaxation of elastic stresses. Radiation relaxation is characterized by a noticeable regression, reaching 70 percent. A possible interpretation of the phenomena observed is proposed. (auth)

42121 ELECTRON IRRADIATION HARDENING OF ALUMINUM. D. Keefer and A. Sosin (Atomics International, Canoga Park, Calif.). Acta Met., 12: 969-78(Sept. 1964).

A study was made of the effects of electron irradiation at 77°K on the yield stress of Al. For integrated fluxes up to 1.35×10^{18} electrons/cm^2, the increase in yield stress, $\Delta\tau$, was found to exhibit a ½-power dependence on the defect concentration. The increase in yield stress that was incurred upon irradiation at 77°K annealed out between 200 and 295°K. This is the temperature range in which a major resistivity annealing stage occurs (Stage III) in Al. Analysis of the data showed that the radioinduced defect responsible for the hardening in Al introduces a highly tetragonal strain field into the lattice. (auth)

42122 THERMAL DEPINNING OF DISLOCATIONS IN ELECTRON-IRRADIATED COPPER. D. Keefer and A. Sosin (Atomics International, Canoga Park, Calif.). Acta Met., 12: 1041-55(Sept. 1964).

Electron irradiations of Cu samples were carried out at −196°C with integrated fluxes up to 10^{17} electrons/cm^2 at 1.0 Mev. Modulus (resonant frequency) and decrement measurements show that pinning of dislocations by irradiation-produced point defects occurs both at −196°C during irradiation and, after moderate doses, during annealing up to about 100°C. The reverse effect, or depinning, was studied in some detail. The depinning process, which occurs in the range from about 250 to about 500°C (depending on point defect concentration), is attributed to the thermal release of defects from dislocations. Activation energies for this process were found to be quite high (>2 ev) and to increase with decreasing point defect concentration. Various models of the depinning process were explored, the most promising of which is based on concurrent, competing processes of pinning and depinning. (auth)

42123 ELONGATION OF URANIUM SINGLE CRYSTALS DURING NEUTRON IRRADIATION. B. A. Loomis, T. H. Blewitt, A. C. Klank, and S. B. Gerber (Argonne National Lab., Ill.). Appl. Phys. Letters, 5: 135-7(Oct. 1, 1964).

The elongation of uranium single crystals in the [010] direction during thermal neutron irradiation was investigated at 110 and 425°K. The growth coefficients were found to be 150 at 110°K and 9700 at 425°K. (C.E.S.)

42124 IONIZING RADIATION EFFECT ON THE ELECTRIC PROPERTIES OF ORGANIC INSULATING MATERIALS. V. Adamets (Vyskumny Ustav Kahlov a Izolantov, Bratislava). Elektrichestvo, No. 4, 76-9(1964). (In Russian)

The effects of radiation were studied on 20 different organic insulating materials. The irradiation proceeded in a nuclear reactor. The radiation effect was determined by measuring the dielectric constants, as well as coefficients of dielectric losses. The effects of irradiation depend mainly on the radiation temperature and the medium (air, vacuum, neutral atm). With doses up to 100 MRads, the dielectric constant does not change. It was concluded that changes in properties depend on changes occurring in the structure of the material. (P.C.H.)

42125 THE VOLUME RESISTIVITY OF ELECTRICAL INSULATING ORGANIC MATERIALS UNDER IRRADIATION. V. Adamec (Výskummý Ústav Káblov a Izolantov, Bratislava). Intern. J. Appl. Radiation Isotopes, 15: 477-83(Aug. 1964).

The method and results of measurements of volume resistivity of electrical insulating sheets from polytetrafluoroethylene, polystyrene, polycarbonate, polyethylene terephthalate, polypropylene and acetobutyrate under the exposure to x radiation with exposure rates in the range from nearly 10^{-3} up to 10^{3} r/sec are described. The rates of volume resistivity recovery of these materials shortly after the interruption of irradiation are given. (auth)

42126 GAMMA RADIATION EFFECTS ON DIELECTRIC PROPERTIES OF VACUUM-DENSE CERAMICS. V. I. Vorozhtsov and I. S. Filatov (Tomsk State Univ., Siberian SSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 7-11(1964). (In Russian)

Gamma-ray effects on ϵ and tgδ of vacuum-dense ceramics used in metal-ceramic tubes were studied with 91.6% talc, 5.2% kaolin, 3.2% boracite, and 1% BaO. It was observed that in weak fields γ-induced deformation in the material structure at the expense of the vitreous phase takes place only with a large γ dose. Moreover, in the latter case the relaxation losses are reduced and conductivity losses are increased. In strong fields even a low dose increased the ϵ and tgδ due to the strong dependence of gas ionization processes, in pores of materials found in high-frequency electric fields, on the external ionizer. (R.V.J.)

42127 RADIATION DAMAGE: ITS MECHANISMS AND MANIFESTATIONS IN REACTOR MATERIALS. Robert J. Bosnak (Massachusetts Inst. of Tech., Cambridge). J. Am. Soc. Naval Engrs., 72: 15-23(Feb. 1960).

A review is presented on the effects of various types of radiation on mechanical and physical properties of metals that are used in reactors. The minimization of radiation effects is also discussed. (P.C.H.)

42128 TRANSMISSION ELECTRON MICROSCOPICAL EXAMINATION OF IRRADIATED AUSTENITIC STEEL TENSILE SPECIMENS. D. R. Arkell and P. C. L. Pfeil (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nucl. Mater., 12: 145-52(July 1964). (AERE-R-4405)

Thin films prepared from irradiated [$1.0 - 1.6 \times 10^{20}$ n/cm² (>1 Mev), $3.0 - 5.7 \times 10^{20}$ n/cm² (thermal) at temperatures in the range 450 to 750°C] and the corresponding thermal control specimens of a 20 wt % Cr/25 wt % Ni, Nb-stabilized steel were examined in the electron microscope after tensile testing at 650, 700, 750, and 800°C. The irradiated samples exhibited enhanced precipitation within the grains compared with the unirradiated specimens. Furthermore, the irradiated specimens showed little tendency to recover, as evidenced by lack of subgrain formation, under conditions where extensive recovery occurred in the corresponding thermal control specimen. It is suggested that during elevated temperature tensile testing the radioinduced precipitation within the grains makes dislocation movement difficult so that deformation of the grain is limited and high stresses are placed on the grain boundaries resulting in intergranular failure and reduced ductility. (auth)

42129 EFFECTS OF NEUTRON IRRADIATION ON THE ROOM AND ELEVATED TEMPERATURE TENSILE PROPERTIES OF 20 wt % Cr 20 wt % Ni STABILISED AUSTENITIC STEELS. J. Fennell and A. C. Roberts (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nucl. Mater., 12: 167-72(July 1964). (AERE-R-4465)

The effects of neutron irradiation at ~80°C on the room and elevated temperature tensile properties of 20 wt % Cr/20 wt % Ni steels, stabilized with Nb or Ti respectively and in two conditions of prior heat treatment, were investigated. Irradiation increases the proof and ultimate tensile stresses and reduces the elongation to fracture in the tests at room temperature and 200°C. The changes in properties were interpreted in terms of the interstitial atoms and vacant sites introduced in the lattice by fast neutron-atom collisions and were recovered on testing at 400°C due to annihilation or redistribution of the point defects. The proof and ultimate stresses at 750 and 850°C were unaffected by irradiation but the elongations to fracture were reduced especially at 860°C. This loss in ductility at the higher test temperatures cannot be recovered by annealing at 1000°C. Suggestions are made as to possible mechanisms involved. (auth)

42130 BUBBLE DIFFUSION AND COALESCENCE DURING THE HEAT TREATMENT OF MATERIALS CONTAINING IRRADIATION-INDUCED GASES. M. V. Speight (Central Electricity Generating Board, Berkeley, Glos., Eng.). J. Nucl. Mater., 12: 216-20(July 1964).

The process of bubble diffusion and coalescence during the annealing of material containing insoluble radioinduced gases was analyzed. An expression was obtained for the average bubble size in terms of annealing time and temperature that depends upon the influence of dislocations, and this was compared with experimental results. The analysis included the case where solid precipitates in the material impede bubble movement. (auth)

42131 ELECTRICAL PROPERTIES OF IRRADIATED AND PERIODICALLY ANNEALED GRAPHITE. S. Aronson, D. G. Schweitzer, R. M. Singer, and J. G. Davis (Brookhaven National Lab., Upton, N. Y.). J. Nucl. Mater., 12: 257-9(July 1964). (BNL-7686)

Measurements of the Hall coefficient and electrical resistivity were made in order to obtain information on the electronic changes occurring in alternately irradiated and annealed graphite. The measurements were made at −194°C. One group (group A) was annealed in a stepwise manner at selected temperatures up to 350°C (one hour at each temperature) after each 15 Mwd irradiation period. Samples in group H were first irradiated continuously for 250 Mwd and were annealed at 350°C after each additional 15 Mwd irradiation. The data on group A indicate that essentially all the damage produced during each irradiation is recovered during the subsequent anneal. The Hall coefficient, length-change, and c-axis measurements on the group H samples show that a net decrease in damage occurs after each irradiation and annealing cycle. The effect of irradiation, thus, depends strongly on the irradiation and annealing history of the graphite. (P.C.H.)

42132 CORROSION CHARACTERISTICS OF QUARTZ AFTER X-IRRADIATION. Walter Gorski (Max-Planck-Gesellschaft, Gottingen, Ger.). Naturwissenschaften, 51: 308(1964). (In German)

Polished quartz samples were partially irradiated with 3.3×10^{7} R and etched in 10% HF. The irradiation sites dissolved faster, but only on the base and not on the other principal crystal surfaces. Considerable variations were found in the etch behavior of crystals from different localities, which indicated the importance of impurities in quartz corrosion behavior. (J.S.R.)

42133 IRRADIATION TEST ON SWAGED UO_2 FUEL. III. MACROPHOTOGRAPHY ON SECTIONED SURFACE OF FUEL RODS. Shuichiro Takahashi, Yoshinobu Seki, Tadashi Kubota, Yutaka Honda, and Tadahide Nohara (Mitsubishi Atomic Power Industry, Inc., [Tokyo]). Nippon Genshiryoku Gakkaishi, 6: 437-41(Aug. 1964). (In Japanese)

Macrophotography on the sectioned surfaces of cold swaged UO_2 fuel rod, hot swaged UO_2 fuel rod, and sintered UO_2 pellets fuel rod, which were irradiated at the W.T.R. to 2700 Mwd/t−UO_2 and 10 ~ 13 kw/ft in burn-up and heat generation rate respectively, are described. A large radial crack was observed in the center position of swaged rod, and other parts of the rod were found uniform. A circular large crack, which plays a role to reduce thermal conductivity, was observed in hot swaged rod. In swaged rods, sintering and shrinkage occurred producing 50 μ gap to sheath tube. The density increase was estimated to be 2% on the basis of the gap width. (auth)

42134 THE FRICTIONAL PROPERTIES OF IRRADIATED LINEAR POLYMERS. Kiyoshi Matsubara and Makoto Watanabe. Nippon Kikai Gakkai Rombunshu, 28: 322-30(Mar. 1962).

Linear polymers were γ irradiated by a ^{60}Co source up to $5 \times 10^{7} \sim 2.5 \times 10^{9}$ R at room temperature. Test results on the frictional behavior and changes in mechanical properties under a sliding velocity of 0.01 cm/sec are discussed. The coefficient of friction (μ) of crosslinking of polyamide and high-density polyethylene increases from 2 ~ 4 times over that of the non-irradiated sample ($\mu = 0.2 \sim 0.4$) with increasing radiation dosage. However, μ of the low-density polyethylene decreases gradually to about $\frac{1}{2}$. The increase of the degraded polymers of fluorocarbons is less than above. The dosage dependence curve of the coefficient α, determined by $\mu \alpha W^{-\alpha}$(W = load) is similar to the reversed curves of stiffness, hardness (P), and shearing strength (S). The μ and S/P are nearly in accord qualitatively but not quantitatively. (OID)

42135 POINT DEFECT STUDIES IN GOLD BY ELECTRON IRRADIATION AT LOW TEMPERATURES. III. RESISTIVITY RECOVERY FROM 240-340°K (STAGE III). Walter Bauer and A. Sosin (Atomics International, Canoga Park, Calif.). Phys. Rev., 136: A474-80(Oct. 19, 1964).

The recovery of electrical resistivity of 99.999%-pure gold after 2-Mev electron irradiation near 80°K was studied. It was found that the recovery in the last 55% of stage III (240–340°K) is characterized by second-order annealing kinetics with an activation energy of 0.80 ± 0.04 ev. The second-order nature of the recovery and other related evidence indicate that the recovery process consists of the random recombination of interstitials and vacancies. (auth)

42136 INVESTIGATION OF THE FLOW REGIONS OF NEUTRON-IRRADIATED COPPER SINGLE CRYSTALS. I. ELECTRON MICROSCOPIC AND MECHANICAL STUDY IN SAMPLES BEFORE AND AFTER ANNEALING. Ch. Schwink and G. Grieshammer (Universitat, Munich). Phys. Status Solidi, 6: 665-78(Sept. 1, 1964). (In German)

Electron microscopic observations showed that the number of irradiation defects that are greater than 50 Å increases during the first stages of mild annealing. Only more intensified annealing diminished this number. The critical shear stress τ_0 of irradiated crystals, measured between 77 and 510°K, showed a curvature in the $\tau_0^{2/3} - T^{2/3}$ diagram, which first vanishes and is then reversed by increased annealing. It is suggested that this is due to a reduction of the number of glide obstacles with annealing. Seeger's theory was modified for this case. There was not a proportional increase of τ_0 with ln $\dot{\epsilon}$ at room temperature, a $\Delta\tau_0 \sim \ln \dot{\epsilon}$-relation was approached only after prolonged annealing. In the light of the results, calculation of an activation energy U_0 from the measurements seemed to be even more doubtful formerly. However, an increase of U_0 with annealing could be estimated with some confidence. (auth)

42137 INVESTIGATION OF THE FLOW REGIONS OF NEUTRON-IRRADIATED COPPER SINGLE CRYSTALS. II. CINEMATOGRAPHIC MEASUREMENT OF SLIP RATE IN ANNEALED AND UNANNEALED SAMPLES. Ch. Schwink and H. Neuhaeuser (Universitat, Munich). Phys. Status Solidi, 6: 679-92(Sept. 1, 1964). (In German)

A cinematographic method is described for measuring the strain rate $\dot{a}$ of neutron-irradiated Cu crystals. Since the glide process is inhomogeneous the values for $\dot{a}$ are much greater than with homogeneous glide. After a radiation dose of about 2×10^{18} nvt (>0.1 Mev) it was found that at room temperature $\dot{a} = 1 \ldots 4 s^{-1}$, to be compared with $\dot{a} \approx 5 \times 10^{-4}\ s^{-1}$, if homogeneous glide occurs. The method enables a study to be made of the connection between the strain rate $\dot{a}$ and the deformation rate $\dot{\epsilon}$ of the deforming apparatus. There exists only a linear relationship between $\dot{a}$ and $\dot{\epsilon}$, not a proportionality, as was assumed hitherto. With this result an explanation was obtained for the measurements of the strain rate dependence of the critical shear stress given previously. The measurements described were made only at room temperature. (auth)

42138 GAMMA EFFECTS ON THE MOBILITY OF ATOMS IN ALLOYS. I. Ya. Dekhtyar and A. M. Shalaev. Sb. Nauchn. Rabot Inst. Metallofiz., Akad. Nauk Ukr. SSR, No. 18, 26-31(1964). (In Russian)

It was established previously that the properties of nonequilibrium systems are affected by exposure to γ radiation; it was assumed that some of these changes are due to the γ-induced increase in the mobility of atoms. The validity of this assumption was examined by studying the changes in the electric resistance of a nonequilibrium Ni–Mn alloy, containing up to 10 atomic % of Mn, after exposure to a ^{60}Co γ source. The alloy was in the unordered state and its electric resistance was a linear function of the Mn concentration. The 100 × 1 × 0.035 mm specimens, with a concentration gradient at the surface, were prepared by evaporation in the vacuum at high temperatures. It was found that the resistance of the specimens changed from the original 0.4731 ± 2 to 0.4743 ± 2 and 0.4750 ± 2 10^{-4} ohm after exposure to 1.08 and 2.44 10^{4} C/kg, respectively, thus exhibiting a nearly linear increase. It was concluded that irradiation of a sample possessing a concentration gradient changes the prevailing system and creates a new distribution, which is equivalent to a certain temperature. The diffusion coefficient calculated on the basis of the derived formula and the experimental measurements was found to correspond to the effects of a temperature of 850°C. Thus, the overall effect of the increased mobility of the atoms under radiation in the case of excess defect concentration is equivalent to a certain increase of the temperature. (TTT)

42139 ANNIHILATION OF POSITRONS WITH ELECTRONS IN GADOLINIUM. I. Ya. Dekhtyar, S. G. Litovchenko, and V. S. Mikhalenkov. Sb. Nauchn. Rabot Inst. Metallofiz., Akad. Nauk Ukr. SSR, No. 18, 198-201(1964). (In Russian)

It was shown previously (Doklady Akad. Nauk SSSR, 147: 1332(1962)) that on the annihilation of positrons by electrons in an ordered alloy the transition of the alloy through the order point is accompanied by changes in the energy levels of the conductivity electrons; under certain conditions, the stabilization of the ordered state may be controlled by the Fermi energy. Similar considerations prevail in the transition from the antiferromagnetic to the paramagnetic state, affecting the shape of the angular correlation curve of the γ quanta generated by the annihilation of the positrons by electrons. The problem was further examined by studying the effects of structural and magnetic transformations on the nature of the annihilation spectra. The annihilation of positrons by electrons from Gd during passage through the Curie point was investigated. The angular correlation of the γ quanta was determined at 20 and 11°C, corresponding to the paramagnetic and the ferromagnetic states of Gd. The angular correlation curves, which reflect the pulse distribution of the electrons, indicated that the phase density increases by about 15% upon passage through the Curie point. This is considerably above the experimental error and tends to confirm the previous assumptions. A complete analysis of the results was made difficult by the fact that for high-atomic-number atoms, especially for transition metals, such as Gd, the electrons of the deeper shells also participate in the formation of the annihilation spectra, in addition to the conductivity electrons. (TTT)

42140 FOCUSING OF ATOMIC COLLISIONS IN CRYSTALS. P. I. Garber and A. I. Fedorenko. Usp. Fiz. Nauk, 83: 385-432(July 1964). (In Russian)

A review is given of theoretical concepts on the mechanism of atomic focusing in a crystalline lattice during fast-particle bombardment of solids. Basic experimental data on cathode spallations, metal spallation, etc., are generalized and discussed. (R.V.J.)

42141 USE OF COLOR CENTERS FOR DETECTION AND MEASUREMENT OF DEFECTS. P. W. Levy (Brookhaven National Lab., Upton, N. Y.). p.3-19 of "Symposium on the Chemical and Physical Effects of High-Energy Radiation on Inorganic Substances." Special Technical Publication No. 359. Philadelphia, American Society for Testing and Materials, 1964.

Application of the color center technique for the detection and measurement of defects in non-metal materials is described. It was found that the number of defects produced in NaCl is in agreement with the current theories, and that both Al_2O_3 and fused silica must be heated to 700 or 750°C to remove the (optically) observed reactor-induced defects. It was also found that the number of vacancies induced in NaCl could be determined as a function of the energy of the incident neutrons. The relation between crystal temperature and defect formation could also be determined simply by doing irradiations at different temperatures. In general, it appears that almost any radiation damage phenomena that involve defects that can be converted into color centers can be studied by the techniques described or by similar ones. (P.C.H.)

42142 LOW-ENERGY RADIATION DAMAGE PROCESSES IN A BODY-CENTERED CUBIC LATTICE. Cavid Erginsoy (Brookhaven National Lab., Upton, N. Y.). p.79-97 of "Symposium on the Chemical and Physical Effects of High-Energy Radiation on Inorganic Substances." Special Technical Publication No. 359. Philadelphia, American Society for Testing and Materials, 1964.

To the extent that the interatomic potentials at the separations of interest to radiation damage processes can be accurately estimated and simulated by two-body central forces, dynamic calculations using a large-capacity digital computer can give a good account of the details of the displacement processes. This is illustrated in the case of a bcc lattice simulating α-iron. The key mechanism of displacement at low energies is a dynamic replacement by the knock-on. This is accompanied by a more or less extended chain of replacements, and the interstitial is formed several atomic distances from the vacancy. The stable defect appears to be a (110) oriented split interstitial in two different types of potential used. The threshold energy for displacing an atom is highly dependent on direction. As a result of the directional dependence of the threshold energy, the integrated probability of displacement is a slowly rising function of knock-on energy, in contrast to the step-function form used in the simple theory of displacement. Calculations indicate that the damage at knock-on energies lower than 35 ev is due to the formation of defects by (100) replacement chains and the damage rate is considerably lower than at higher energies. (P.C.H.)

METEOROLOGY

Refer also to abstracts 41344, 41664, and 41706.

42143 (CEA-R-2347) ETUDE DU COMPORTEMENT DES AEROSOLS RADIOACTIFS ARTIFICIELS. APPLICATIONS A QUELQUES PROBLEMES DE CIRCULATION ATMOSPHERIQUE (THESIS). (Study of the Behavior of Artificial Radioactive Aerosols. Applications to Some Problems of Atmospheric Circulation (thesis)). Gerard Lambert (Francis. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1963. 214p.

Submitted to Univ. of Paris.

An examination of the behavior of radioactive aerosols produced in the atmosphere by nuclear explosions was made in order to deduce the most general laws governing atmospheric circulation and diffusion. After a general table of the radioactive aerosols present is given, the validity and the precision of the measurement methods and the concentration of the aerosols at ground level and in the upper atmosphere is considered, as well as their deposition on the ground. The existence is thus demonstrated of a trophospheric equatorial barrier and of discontinuous and seasonal aspects of stratosphere-troposphere transfers. The role is shown of precipitations and dry autofiltration in the lower atmosphere cleaning processes. This work makes it possible to describe the general behavior of dust from the stratosphere, and to improve the total radioactive contamination of the globe. (auth)

42144 (AEC-tr-6464) COMPARATIVE ANALYSIS OF THE OBSERVED PLANETARY DISTRIBUTIONS OF THE CONTENT OF OZONE AND CERTAIN RADIOACTIVE ISOTOPES IN THE ATMOSPHERE. I. L. Karol'. Translated from a publication of the State Committee for the Peaceful Uses of Atomic Energy, USSR, Moscow, 1963. 27p.

A comparative review is conducted of the literature on the meridional distributions and seasonal variations of the ozone and certain radioisotopes (particularly strontium-90) at various levels of the atmosphere. Hypotheses on the causes of the observed distributions and variations are discussed. The data show good agreement of the ozone and radioisotope distributions in the spring and autumn in the middle and upper troposphere and in the layer of the lower stratosphere adjoining the troposphere, indicating that the exchange of air masses through the tropopause occurs with the same intensity at all the extratropical latitudes. (D.L.C.)

42145 ATMOSPHERIC DIFFUSION-DEPOSITION STUDIES OVER FLAT TERRAIN. N. F. Islitzer and R. K. Dumbauld (Weather Bureau Research Station, Idaho Falls, Idaho). Air Water Pollution, 7: 999-1022(Dec. 1963).

Extensive measurements of particle dispersion from a ground-level source to 3 to 2 km were carried out covering a wide range of atmospheric stabilities. A fluorescent tracer, uranine dye in small-particulate form, was released for 60-min. periods over a grid 60° wide with sampling arcs operated at 100, 200, 400, 800, 1600, and 3200 m downwind during some of the tests. An additional series of tracer releases were conducted with sampling near the ground to 800 m downwind and in the vertical direction on 30-m towers located 200 or 400 m downwind. Measurements of the vertical temperature gradient, wind velocities and gustiness were made near the tracer-release point. The test site was quite flat and covered with sagebrush elements about 50 cm high. The horizontal particle dispersion was found to be well predicted in unstable atmospheres by the standard deviation of the horizontal wind direction after averaging the wind direction record by a time dependent upon the travel time from the source to the particular sampling arc. A value of 5 for β, the ratio of the Lagrangian to Eulerian time scales, gave the best overall agreement between measured and predicted horizontal dispersion during unstable conditions. A constant value for β did not achieve satisfactory results in stable atmospheres, but a 10-sec averaging time on the horizontal wind direction record regardless of the travel times involved seemed suitable for the horizontal particle dispersion predictions to 3200 m distance. Deposition rates of the tracer on the surface were determined by material-balance computation from the air concentration measurements on the row of 30-m towers. Up to a 50 per cent loss of tracer in a distance of 400 m was measured. Deposition rates measured on specially made flat plate detectors were usually at least an order of magnitude less than those determined from material-balance calculations, which may have been attributable to the dissimilarity between the flat plates and the grid surface. Vertical dispersion, as computed from ground-level air concentration and the equation of continuity, was not in good agreement with predictions from time-averaged vertical wind direction records. The vertical dispersion determined from the air concentration measurements on the towers at one distance was found to be in reasonable agreement with vertical gustiness data, but this conclusion must be considered tentative until additional measurements have been made. Air concentrations measured in unstable atmospheres were in good agreement with values predicted from a model employing horizontal and vertical gustiness and a deposition velosity to account for the removal of tracer from the air to the ground. The agreement between predicted and measured values was less satisfactory for inversion cases. (auth)

42146 SOLAR EMISSION EFFECTS ON THE DISTRIBUTION OF FALL-OUT PRODUCTS IN THE ATMOSPHERE. D. L. Simonenko. At. Energ. (USSR), 17: 130-6 (Aug. 1964). (In Russian)

A study is made of the effect of solar emission on the movement of radioactive aerosols in the lower stratosphere and on aerosol-particle transfer from the stratosphere into the troposphere. 36 references. (tr-auth)

42147 ON THE RADIOACTIVITY PROFILE IN AIR OF CLOUDS. B. I. Styro, E. I. Vebra, and K. K. Shopauskas (Inst. of Geology and Geography, Academy of Sciences, Lithuanian SSR). Lietuvos TSR Mokslu Akad. Darbai, Ser. B, No. 1, 3-9(1964). (In Russian)

Measurements of the natural radioactivity of the air inside and outside a cloud produced a series of radioactivity profiles. It is shown that the radioactivity at the air-cloud boundary is much less and that fluctuations of radioactivity in the cloud are very slight. Formulas were derived for determining the variations in cloud radioactivity with elevation. Radioactivity of a cloud air depends on aerosol coagulation, the number of droplets, and the radon concentration. (auth)

42148 VERTICAL DISTRIBUTION OF RADON DAUGHTER PRODUCTS IN THE TROPOSPHERE UNDER VARIOUS METEOROLOGICAL CONDITIONS. K. K. Shopauskas (Inst.

of Geology and Geography, Academy of Sciences, Lithuanian SSR). Lietuvos TSR Mokslu Akad. Darbai, Ser. B, No. 1, 21-8(1964). (In Russian)

Results from alpha activity monitoring indicated that the mean distribution of radon decay products in the air, during cloudless weather, is subject to an exponential law. Deviations from the law are induced by meteorological changes. Radon decay products rapidly diminish in clouds. Natural α activity begins to increase above 5.5 to 6 km. (tr-auth)

42149 SAMPLER FOR UPPER TROPOSPHERIC CARBON DIOXIDE. Tadayoshi Kubozoe, Joichi Yokota, and Kumiko Umezawa. Radioisotopes (Tokyo), 13: 282-6(July 1964). (In Japanese)

A new sampler that was successfully carried by an F-86-F jet fighter for collection of upper tropospheric carbon dioxide at an altitude up to 35,000 feet is described. The sampler was designed to make use of the type 4 A molecular sieve (4 × 8 mesh) to absorb the carbon dioxide. The amount of carbon dioxide obtained in $\frac{1}{2} \sim 1$ hour of sampling time was $2 \sim 4$ cc STP per gram of molecular sieve, the content of carbon dioxide absorbed at altitudes other than sampling ones was less than 5%, being satisfactory for accurate ^{14}C measurements. (auth)

42150 METEOROLOGICAL EVALUATION OF THE SOURCES OF IODINE-131 IN PASTEURIZED MILK. R. J. List, K. Telegadas, and G. J. Ferber (U. S. Weather Bureau, Washington, D. C.). Science, 146: 59-64(Oct. 2, 1964).

An examination of possible sources of radioiodine found in samples of milk in the midwestern states during May and early June 1962 shows that atmospheric testing at Christmas Island was the principal contributor to incidents of significant concentrations of iodine-131 in milk (exceeding 300 picocuries per liter). Underground testing at Nevada played at most only a minor role during this period. There is a cause-and-effect relationship between the penetration of thunderstorms into high concentrations of nuclear debris in the lower stratosphere and the subsequent amount of iodine-131 in milk. Analyses of samples of rainwater confirm the importance of this scavenging mechanism. The relative contributions of atmospheric and underground testing to the iodine-131 found in milk samples from September 1961 to December 1962 were reviewed and only one incident in which the amount of iodine-131 exceeded 300 picocuries per liter could be attributed to an underground test. (auth)

42151 COAGULATION OF THE SOLID PHASE OF RADIOACTIVE AEROSOLS WITH CLOUD DROPLETS. B. Styro, E. I. Vebra, K. Sopauskas, and T. G. Khundzhua. Soobshch. Akad. Nauk Gruz. SSR, 33: 61-7(1964). (In Russian)

By making airborne measurements of atmospheric α-particles within and outside clouds, the coefficient of coagulation was found to be $\sim 10^{-6}$ to 10^{-4}/sec, and the half-period of purging by other than radioactive decay was 1 to 2 min. (P.C.H.)

PHYSICS

General

Refer also to abstract 42885.

42152 (ANL-6879) PHYSICS DIVISION SUMMARY REPORT, APRIL 1, 1963–MARCH 31, 1964. Annual Review. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 165p.

Separate abstracts were prepared for the seven sections of the report. (D.C.W.)

For abstracts of individual sections see: 42295, 42622, 42623, 42624, 42625, 42626, and 42627.

42153 (AROD-3323:4) DYNAMIC PINCH PUMPING SOURCE. Report No. 64-7. I. Gorog (California. Univ., Berkeley. Electronics Research Lab.). Mar. 29, 1964. Contracts DA-ARO-D-31-124-G-317 and AF-AFOSR-117-63. 42p.

The potentials of a magnetically compressed plasma as a high-intensity light source are investigated. The physical arrangement is that of a dynamic pinch. The motion of the confined plasma column is studied both experimentally and theoretically throughout a wide range of parameters. It is found that the peak intensity of the emitted light in the 2000 to 6000 Å spectral region is maximum when the plasma reaches minimum radius at times comparable to the quarter cycle period of the discharge current. When the parameters are adjusted to give this mode of operation, a single high-intensity light pulse, lasting approximately 2×10^{-6} sec, is emitted. The peak intensity is found to be maximum with xenon as the filling gas. The absolute intensity of the light emitted from helium, air, argon, and xenon plasmas is measured. The results indicate that a dynamic pinch arrangement can be employed in order to obtain peak intensities significantly in excess of those available from conventional flash lamps. The time integrated intensity, however, is limited by the inherently instable nature of the pinched plasma. This instability restricts the pulse duration to a few microseconds. (auth)

42154 (IS-811) PIEZORESISTANCE OF N-TYPE Mg_2Si. W. B. Whitten and G. C. Danielson (Ames Lab., Ames, Iowa). [Dec. 1963]. Contract [W-7405-eng-82]. 13p. (CONF-679-1)

From International Conference on the Physics of Semiconductors, Paris, July 1964.

The piezoresistance tensor components of n-type Mg_2Si were measured from 77 to 300°K. From these measurements and the elastic constants, the elastoresistance components m_{11}, m_{12}, and m_{44} were obtained. Each component varies linearly with reciprocal temperature. The relative slopes indicate that the conduction band of Mg_2Si can be described by a many-valley model having energy ellipsoids in the $\langle 100 \rangle$ directions. Thus, the electronic structure of the conduction band of Mg_2Si appears to be similar to that of silicon. The smaller magnitudes of m_{11}, m_{12}, and m_{44} suggest that the ellipsoids in Mg_2Si are more nearly spherical than the ellipsoids in silicon, or that the deformation potential Ξ_u is small. (auth)

42155 (ML-1190) ON SHARP OPTICAL TRANSITIONS IN CRYSTALS—EFFECTS OF STATIC AND DYNAMIC PERTURBATIONS. G. F. Imbusch (Stanford Univ., Calif. Microwave Lab.). July 1964. Contract DA-31-124-ARO-D-208. 162p. (AD-604659; AROD-3780:1)

This investigation is concerned with the effects of some perturbations on the sharp optical lines emitted by chromium and vanadium ions in MgO. Because the atomic states of the impurity ion are dependent on the lattice environment, it is possible to modify the radiation from such impurity ions by perturbing the host crystal. The following effects are investigated: (i) the effect of the perturbations caused by lattice vibrations (phonons) on the radiation, and (ii) the effects of static perturbations (pressure, magnetic fields, and electric fields) on the optical transitions. At absolute zero the crystal ions are in motion due to the presence of the zero-point vibrations. As the temperature is raised, the vibrational motion of the ions increases. Because the impurity ion is affected by these vibrations, the following effects occur. The optical lines emitted by the impurity shift and broaden as the temperature is raised. Emission or absorption of a phonon may accompany the radiation process and, as a result, vibrational sidebands appear near the sharp line. The sidebands increase in intensity and extent as the temperature is raised. The temperature-dependent shift and broadening of the optical lines were measured and found to be in excellent agreement with theory. A calculation of the isotope shift due to the ion-phonon interaction was made and was found to explain the observed isotope shift in the ruby R lines. A similar isotope shift was sought and found in the R line of $MgO:Cr^{3+}$. Vibrational sidebands were studied experimentally and theoretically. These can yield detailed information on the vibrational motion of the impurity ion. It is shown experimentally that the vibrational spectrum of the impurity is modified when the coupling between the impurity and the lattice changes. These results give experimental substance to the theoretical concepts of quasi-localized vibrational modes near an impurity. These experiments indicate that an impurity ion, which is tightly bound to the whole lattice and which is capable of emitting sharp optical lines, can be used as a high resolution probe to examine both the vibrational spectrum of the host lattice and the vibrations of the impurity ion itself. There is a very clear analogy between the sharp optical line and its vibrational sideband and the sharp recoil-less γ ray Mössbauer line and its background. An attempt to induce electric dipole radiation into the magnetic dipole R line of $MgO:Cr^{3+}$ was unsuccessful. This negative result seems to indicate a basic inadequacy of the point charge model to predict electric field effects in $MgO:Cr^{3+}$. A complete analysis of such experiments needs to include the effects of partially covalent bonding. The radiation emitted by chromium ions situated near a vacancy in the lattice is examined. Under a static pressure or a magnetic field the lines split into several components. By studying the polarizations of these components, it was found that the radiation is mainly magnetic dipole but that a detectable amount of electric dipole radiation is also present. (auth)

42156 (MPI/PA/7/64) KINETISCHE GLEICHUNGEN UND INTEGRABILITATSBEDINGUNG IM VIELZEITEN-FORMALISMUS. (Kinetic Equations and Integrability Condition in the Many-Time Formalism). D. Frank, D. Pfirsch, and S. Priess (Max-Planck-Institut fur Physik und Astrophysik, Munich). [1964]. 12p.

A class of common differential equations and a special example of the many-time process as a method for solving the BBGKY equations are discussed. The formulas proposed by Sandri and Su for calculation of corrections to the Landau equation were investigated to determine their range of application. (tr-auth)

42157 (NP-14228) EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH ANNUAL REPORT, 1963. (European Organization for Nuclear Research, Geneva). 181p.

An account of CERN's activities in 1963 is given. Information is included on: the development and operation of the proton synchrotron, synchrocyclotron, and bubble chambers; nuclear physics and chemistry; experimental and theoretical studies on elementary particles; data handling; construction of buildings and site; safety and health physics; finances and administration; publications and technical training; history and organization; and engineering and research programs. (N.W.R.)

42158 (NP-14281) PROCEEDINGS OF THE BLACK HILLS SUMMER CONFERENCE ON TRANSPORT PHENOMENA (MAINLY HEAT FLOW AND CHARGE FLOW IN SEMICONDUCTORS AT ELEVATED TEMPERATURES), AUGUST 21-23, 1962, RAPID CITY, SOUTH DAKOTA. Final Report. (South Dakota School of Mines, and Tech., Rapid City). Oct. 15, 1962. Contract Nonr(G)-00064-62. 280p.

Separate abstracts were prepared for 5 of the 16 papers included; the remaining papers are on thermal conductivity of silicon at 1000°K, the absolute measurement of thermal conductivity, thermal measurements on barium titanate ceramics, measurement of thermal conductivity in thermistors, Hall mobility in germanium, low-temperature electrical resistivity of rare-earth metals, the theory of electrical and thermal conductivity in solids, mixed conduction in semiconductors, semiconducting properties of $Hg_{1-x}Cd_xTe$, field emission from semiconductors, and properties of non-stoichiometric semiconductors. (R.E.U.)

For abstracts of individual papers see: 41302, 41715, 41716, 42016, and 42159.

42159 (NP-14281(p.33-46)) THERMAL DIFFUSIVITY MEASUREMENT OF A FINITE DISK. Paul Dean Maycock (Ames Lab., Ames, Iowa).

A technique was developed for measuring the thermal diffusivity of finite disk-shaped samples. The radial heat flow equation was solved by the method of finite differences. An axial heater was turned on and the temperatures at three radial positions were measured as functions of time. This procedure determined the boundary conditions necessary for the solution of the heat flow equation. By assuming various values of the thermal diffusivity, the solution at the middle thermocouple was obtained. The value that gave the best agreement between the computed solution at the middle thermocouple and the experimental curve obtained at the midpoint was considered to be the best value for the diffusivity. A FORTRAN program, which calculates the diffusivity from the experimental data, was developed and an IBM 704 computer was used to process the data. Data on Armco iron show that the method is capable of giving correct values for thermal diffusivity. (auth)

42160 (ORNL-P-295) APPLICATION OF SEMIEMPIRICAL COUPLING RULES TO THE ANALYSIS OF MAGNETIC STRUCTURES. M. K. Wilkinson (Oak Ridge National Lab., Tenn.). [196?]. Contract W-7405-eng-26. 19p. (CONF-690-1)

From Advanced Course on Magnetic Exchange Interaction on Transition Metal Compounds, Kjeller, Norway, Sept. 1964.

The semiempirical rules for the ordering of magnetic moments through indirect exchange processes are applied to many perovskite-type structures and trifluorides with slight distortions from cubic symmetry. It is shown that these rules can account for the observed magnetic structures. (D.L.C.)

42161 (ORNL-P-297) SEMIEMPIRICAL RULES OF SPIN ORDERING. M. K. Wilkinson (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 19p. (CONF-690-3)

From Advanced Course on Magnetic Exchange Interaction on Transition Metal Compounds, Kjeller, Norway, Sept. 1964.

Semiempirical rules of magnetic coupling are discussed with regard to simple crystal structure where the magnetic exchange interactions are unambiguous. The exchange interactions are assumed to take place by overlap between the cation orbitals and intervening anion orbitals, and the cation orbitals considered are those stabilized by ligand fields. The rules were developed from experimental neutron diffraction analyses of magnetic structures. (R.E.U.)

42162 (TID-20963) QUARTERLY PROGRESS REPORT NO. 74, JULY 15, 1964. H. J. Zimmermann and G. G. Harvey (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Contracts AT(30-1)-1842, DA36-039-AMC-03200(E), and AF33(615)-1083. 289p.

Research progress in radio physics, plasma dynamics, and communication sciences and engineering is reported. Results are included on cesium clock stability, maser development, molecular beam acceleration, effects of light on organic compounds, microwave emission and absorption, infrared absorption spectra, dielectric constants, antiferromagnetic resonance, plasma dynamics, nuclear energy levels, radiation belts, electric discharges, gas flow, sound production and interactions, x-ray reflection, electron beam interactions, thermoelectric properties in metal vapors, communication theory, and biophysics. (D.C.W.)

42163 (UCRL-11595) STATISTICAL THEORY OF NONLINEAR EFFECTS IN THE POLARIZATION OF AN IMPERFECT GAS (thesis). Louis Thornton Klauder, Jr. (California. Univ., Berkeley. Lawrence Radiation Lab.). July 24, 1964. Contract W-7405-eng-48. 104p.

Systematic derivations of useful formulas for the electrostriction and the nonlinear polarization in a gas of neutral molecules are presented. The derivations begin with the definitions from quantum statistical mechanics for the grand canonical ensemble averages of the two quantities in question, and the resulting formulas are obtained by means of a method devised by Kaufman and Watson. (auth)

42164 (UJV-944/63) METODIKA MĚŘENÍ GRADIENTU MAGNETICKÉHO POLE VE ČTYŘPÓLOVÉM A SÉSTIPÓLOVÉM MAGNETU. (A Method of Measurement of the Gradient of the Magnetic Field in Quadrupolar and Hexapolar Magnets). M. Karmasin and J. Slavík (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1961]. 16p.

A technique for direct measurement of the gradient of a magnetic field using an oscillating coil is described. From the complex potential of the field of a quadrupolar and of a hexapolar magnet are derived analytical expressions for the gradient of the field. Also the electromotive force induced in an actual coil oscillating in the field of such magnets is calculated. A prototype of a vibrating magnetometer is described, and some results obtained with a brand of manufactured apparatus are given. Drawings giving dimensions of the recommended oscillating coil and the arrangements for positioning and driving it are included. The coil is driven by the moving coil of an ordinary electrodynamic speaker. A block diagram of the electrical hook-up of the magnetometer is included as well as a photograph of the assembly. (TTT)

42165 (AEC-tr-6480) ON THE INFLUENCE OF COMPRESSION SHOCKS IN THE TRANSITION ZONE BETWEEN THE GAS-DYNAMIC AND MOLECULAR FORM OF FLOW. K. Bier. Translated for Oak Ridge Gaseous Diffusion Plant, Tenn., from Fortschr. Physik, 11: 325-56(1963). 52p.

Information on the effects of compression shocks in the transition zone between gas dynamic and molecular flow was obtained by means of test methods developed for the production of molecular beams and for isotope separation by the nozzle process. The form of the shocks in freely expanding gas jets was studied, and the velocity distribution of the molecular beam was used to demonstrate the compression shock effect on the flow rate and temperature. Finally, the separating effect of the shock in the flow of a gas or isotope mixture is considered. (D.L.C.)

42166 (JPRS-26459) LIQUID METAL IN AN ELECTROMAGNETIC FIELD. I. M. Kirko. Translation of p.1-160 from "Zhidkiy Metall v Elektromagnitom Pole," Moscow-Leningrad, 1964. 137p. (TT-64-41717)

This book treats magnetohydrodynamic phenomena in liquid metals and in electrolytes in an electromagnetic field. After the solution of certain magnetohydrodynamic problems, the applications of the phenomena in electromagnetic pumps, mixers, etc., are described. (D.L.C.)

42167 FERMI STATISTICS OF TWO-DIMENSIONAL FREE-ELECTRON SYSTEMS. J. P. McKelvey and E. F. Pulver (Pennsylvania State Univ., University Park). Am. J. Phys., 32: 749-61(Oct. 1964).

The variation of the Fermi energy with temperature and free-particle concentration is calculated analytically for a number of two-dimensional systems, including the free-particle gas, the intrinsic semiconductor, and the impurity semiconductor. These illustrations, while, of course, applicable to certain physically realizable systems, are also of considerable illustrative and pedagogical interest, since the integrals that are involved can invariably be worked out in closed form. The Fermi energy as a function of temperature and concentration may then in some cases be calculated in closed form, while in others it is obtained implicitly as the solution to a fairly simple transcendental equation. The physical significance of the variation of Fermi energy as a function of temperature and concentration is discussed, and the deviation of the n_0p_0 product for the two-dimensional semiconductor from the Boltzmann mass-action result is calculated and discussed in detail. The conditions corresponding to the failure of the Boltzman approximation and the onset of degeneracy are outlined. Application of the calculational methods to simple Bose-Einstein systems is briefly treated. (auth)

42168 COOLING OF HIGH CURRENT SPARK CHANNELS IN HYDROGEN AND ARGON. A. B. Parker and D. E. Poole (Univ. of Liverpool). Brit. J. Appl. Phys., 15: 1011-19(Sept. 1964).

The decay of gas temperature and the recovery of the gas dielectric strength following discharges in Ar and H were measured using Cu and W electrodes of different sizes. The results verified that processes other than gas temperature affect the dielectric recovery of high-current spark gaps. The temperature decay was calculated in reasonable agreement with the observations, using a simple model. (D.C.W.)

42169 THE LOW-PRESSURE DISCHARGE IN THE STRONG IONIZATION REGIME. A. Caruso and A. Cavaliere (CNEN, Rome). Brit. J. Appl. Phys., 15: 1021-9 (Sept. 1964).

A simplified model for the low-pressure discharge is described, in which the finite mean free path of the neutral atoms for ionization is taken into account. On this basis, the spatial distributions of the potential and of the particle densities are calculated for strong ionization, and two mechanisms leading to the limitation of the current are discussed. (auth)

42170 ELECTRONIC CONDUCTIVITY OF SHOCK-HEATED PARTIALLY IONIZED ARGON IN THE PRESENCE OF A MAGNETIC FIELD. Z. Al-Attar, M. R. Barrault, and M. McChesney (Univ. of Liverpool). Brit. J. Appl. Phys., 15: 1057-65(Sept. 1964).

The components of the tensor electronic conductivity are calculated using the Shkarofsky transport equations for the case of shock-heated, partially-ionized argon in the shock Mach number range from 8 to 20 at fore pressures of 0.1, 1.0, 10 torr and for magnetic field strengths of 1 and 2 Wb m^{-2}. The results are compared with earlier simplified calculations; and the continued role of electron-neutral collisions, even at high degrees of ionization, in reducing the electronic conductivity is demonstrated. (auth)

42171 LIOUVILLE EQUATION FOR A RELATIVISTIC CHARGED PARTICLE. F. Henin (Université Libre, Brussels). Bull. Classe Sci., Acad. Roy. Belg. (5), 49: 395-419 (1963).

The Liouville equation for the particle distribution function is given, together with the nonlinear integral equation that defines the perturbed propagators. The equivalence of the two equations up to order e^4 to the power series previously obtained for the reduced distribution function is shown, and equivalence at higher orders is proved by an induction method. The Liouville equation for a relativistic charged particle in an external electromagnetic field is proved. (D.C.W.)

42172 MODELING OF PARTICLE MOTIONS IN CROSSED ELECTRIC AND MAGNETIC FIELDS. N. V. Trikhanova and P. M. Shchanin (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 3-6 (1964). (In Russian)

Modeling of particle motion in crossed electric and magnetic fields varying in the direction of particle motion was studied. Particle trajectories and angular directions of incoming particles are analyzed at various initial conditions. (tr-auth)

42173 TORSIONAL OSCILLATIONS OF A PLANE IN MAGNETOHYDRODYNAMICS. R. E. Kelly (Massachusetts Inst. of Tech., Cambridge). J. Appl. Mech., 31: 547-8 (Sept. 1964).

It is shown that a solution may be obtained for the torsional oscillations of a plane in a viscous fluid by the boundary-layer approach, if the fluid is conducting and a magnetic field exists perpendicular to the plane. (T.F.H.)

42174 AN APPROXIMATE SOLUTION IN MAGNETOHYDRODYNAMICS. J. Fillo (Syracuse Univ., N. Y.). J. Appl. Mech., 31: 555-6(Sept. 1964).

Approximate solutions are developed for the boundary-layer equations of magnetohydrodynamics for small magnetic Reynolds numbers. These solutions can be subsequently used in the collocation method. (T.F.H.)

42175 STUDIES OF A HIGH-GAIN PULSED ^{87}Rb MICROWAVE MASER. P. Davidovits and N. Knable (Columbia Univ., New York). J. Appl. Phys., 35: 3042 (Oct. 1964).

The effects of optical pumping and buffer gases (Ar, H, He, N, and Ne) on the gain of a ^{87}Rb maser (6835 Mc) were studied. The highest gain was obtained with nitrogen. Also, the gain measured under continuous optical pumping was lower than that observed after turning off the pumping light. (D.C.W.)

42176 PROOF OF THE EULERIAN SMALL SIGNAL POWER THEOREM FOR ROTATIONAL ELECTRON BEAMS. David L. Bobroff (Raytheon Co., Waltham, Mass.). J. Appl. Phys., 35: 3044-5(Oct. 1964).

The Eulerian small signal power theorem for rotational beams is proved directly in terms of Eulerian variables. (D.C.W.)

42177 PROPAGATION OF SPACE-CHARGE WAVES ALONG A DRIFTING MULTI-VELOCITY BEAM IMMERSED IN AN INFINITE MAGNETIC FIELD. R. H. C. Newton (General Electric Co. Ltd., Wembley, Eng.). J. Electron. Control (1), 17: 19-32(July 1964).

The one-dimensional, one-degree-of-freedom analysis previously presented is extended to three dimensions and one degree of freedom in order to investigate the effect of surrounding a drifting beam by a conducting cylinder. It is found that the suggestion that space-charge waves can be made evanescent is no longer tenable, but that nevertheless there is a possibility of establishing a region which will reflect negative power carrying waves. (auth)

42178 THE AMPLIFICATION AND TRANSIT TIME OF AN ELECTRON AVALANCHE TRAVERSING A UNIFORM ELECTRIC FIELD GAP. J. Lucas (Univ. of Liverpool). J. Electron. Control (1), 17: 43-8(July 1964).

The amplification (A) and transit time (T) of an electron avalanche while crossing a gap were calculated in terms of the electron ionization coefficient (α) and the electron drift velocity (ν) with allowance for both electron diffusion and electrode effects. It was shown that when both α and ν are calculated from experimental values for A and T, that errors greater than the experimental error may occur if diffusion and electrode effects are neglected. (auth)

42179 THEORY OF STRIATIONS IN GAS DISCHARGES. Louis Gold (Research Inst. for Advanced Studies, Baltimore). Nature, 203: 855(Aug. 22, 1964).

A theory for stationary striations in gas discharges is outlined. (D.C.W.)

42180 CRYSTAL OSCILLATOR FILM THICKNESS MONITOR. A. H. F. Muggleton and F. A. Howe (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 28: 242-4(Aug. 1964).

An assembly for monitoring the thickness and deposition rate of vacuum evaporated films is described, which measures the change in frequency between two similar crystals when the surface of one has a target material evaporated on it. The advantages of this system over more standard assemblies are enumerated. (auth)

42181 STAGNATION POINT LANGMUIR PROBE IN A SHOCK TUBE—THEORY AND MEASUREMENTS. Irvin Pollin (Harry Diamond Labs., Washington, D. C.). Phys. Fluids, 7: 1433-45(Sept. 1964).

Langmuir-type probes consisting of a flat-headed circular cylinder with a collecting electrode at the stagnation point are placed in a shock tube and exposed to supersonic ionized air flow at ion mass fractions less than 10^{-4} and initial shock tube pressure of 1 cm Hg. Stagnation point measurements of ion current density are obtained using negative electrode potentials. The exact gasdynamic stagnation point boundary layer equations and the one-dimensional Poisson equation are solved for an axially symmetric blunt body and ion mass fractions less than 10^{-2}. Calculations of the ion-electron flow in the stagnation point boundary layer are presented for negative electrode potentials. The measurements and calculations agree within the experimental accuracy and the precision to which the physical constants are known. (auth)

42182 KINETIC THEORY OF THE ELECTRON GAS IN A POSITIVE BACKGROUND. II. NONEQUILIBRIUM THEORY. Ralph L. Guernsey (Univ. of Maryland, College Park). Phys. Fluids, 7: 1600-11(Oct. 1964).

A kinetic equation for the electron gas which is not subject to the usual short-range divergence is derived. The method used is the division of the Coulomb potential into a weak part and a short range part. The result is expressed as the sum of a Boltzmann integral for the short range potential and a Balescu integral for the weak part, both of which are convergent. The dominant terms are identical with those obtained from the usual (divergent) Balescu equation with a cutoff in the k integration. An expression is obtained for the nondominant (i.e., nonlogarithmic) correction. (auth)

42183 SCATTERING OF ELECTRONS AND IONS BY DUST PARTICLES IN A GAS. R. C. Dimick and S. L. Soo (Univ. of Illinois, Urbana). Phys. Fluids, 7: 1638-40(Oct. 1964).

Interaction of a partially ionized gas with dust particles was studied. Results generalize the earlier approximation by Rosen. (auth)

42184 RECOMBINATION COEFFICIENT OF ELECTRONS WITH NO$^+$ IONS IN SHOCK-HEATED AIR. R. P. Stein, M. Scheibe, M. W. Syverson, T. M. Shaw, and R. C. Gunton (Lockheed Missiles and Space Co., Palo Alto, Calif.). Phys. Fluids, 7: 1641-50(Oct. 1964).

A measurement of the electron–positive-ion recombination coefficient was made in air of density near 0.1 atm and of temperature about 2900°K, yielding the value, $\alpha = (4 \pm 2) \times 10^{-8}$ cm^3 sec^{-1}. The results indicate that dissociative recombination, $NO^+ + e^- \rightarrow N + O$, is the dominant electron depletion process. Air behind a reflected shock wave at a temperature of 3600°K is expanded rapidly into a thin-wall quartz tube. The tube serves as a post in three X-band waveguides. Electron densities are computed from the measured phase shifts of transmitted microwave signals. The relation between electron density and phase shift is determined with discharge plasmas of known electron densities. The recombination coefficient is computed from the measured electron depletion rate and the time variation of the temperature and velocity of the gas in its unsteady expansion down the quartz tube. The effects of diffusion, attachment, and impurities are also investigated. The measured value of α is in reasonable agreement with that of Lin et al., at 5000°K when a $T^{-3/2}$ temperature dependence is assumed. This result is also compared with other measurements near 300°K. (auth)

42185 BOUNDARY-LAYER SIMILARITY SOLUTIONS FOR ROTATING FLOWS WITH AND WITHOUT MAGNETIC INTERACTION. W. S. King and W. S. Lewellen (Aerospace Corp., El Segundo, Calif.). Phys. Fluids, 7: 1674-80(Oct. 1964).

The laminar boundary layer produced by the rotating flow of a viscous incompressible fluid over a stationary infinite disk is considered. The external velocity is assumed to be tangential and to vary as some power of the radius, i.e., $\nu_\infty \sim r^n$. The case in which the fluid is electrically conducting and interacting with a magnetic field aligned with the axis of the disk is also considered. Boundary-layer similarity equations, containing the parameter n and a magnetic interaction parameter are derived. Solutions for n between plus one (solid-body rotation) and minus one (the potential vortex) are investigated. (auth)

42186 OBSERVATION OF AN INFRARED ABSORPTION BAND FROM s-f EXCHANGE INTERACTION IN ANTIFERROMAGNETIC HOLMIUM. C. Chr. Schueler (IBM Zurich Research Lab., Rüschlikon-ZH, Switzerland). Phys. Letters, 12: 84-5(Sept. 15, 1964).

An expression is given relating energy-band-gaps and the parameters characterizing the s-f exchange interaction along the c-axis of Ho. From a study of the reflection spectrum of Ho at 77°K for photon energies of 0.2 to 0.7 ev, it is inferred that the s-f exchange interaction energy is about 0.1 ev. (T.F.H.)

42187 THEORY OF ELECTROMAGNETIC FIELD MEASUREMENT AND PHOTOELECTRON COUNTING. P. L. Kelley and W. H. Kleiner (Massachusetts Inst. of Tech., Lexington). Phys. Rev., 136: A316-34(Oct. 19, 1964).

A theory of electromagnetic field measurement by means of photoionization is developed and applied to photoelectron counting. A probability theory involving multitime joint probability functions for a sequence of photoionizations is formulated. A general quantum-theory definition is proposed for the nonexclusive probability function which occurs in the probability theory. Approximations are then introduced to derive expressions for this probability function which involve correlation functions of the photoionization detector and the electromagnetic field-plus-source. The general theory is used to derive quantities of interest in photoionization counting experiments. Expressions are derived for the probability $P_n(t,t + T)$ that n photoionizations are observed in the time interval t to t + T, and quantities related to $P_n(t,t + T)$, such as its generating function and various moments. $P_n(t,t + T)$ is found to be a compound Poisson distribution determined by the density operator of the field when the latter is expressed in Glauber's P representation. Using this result, the character of $P_n(t,t + T)$ is examined for several specific density operators. These correspond to a coherent state, various fields with the mode phases distributed independently of the mode amplitudes, and a spread-out coherent state. (auth)

42188 INSTABILITY IN THE QUANTUM HELICON DISPERSION RELATION. N. David Mermin and V. Celli (Univ. of California, San Diego, La Jolla). Phys. Rev., 136: A346-54(Oct. 19, 1964).

The classical stability theorem for the conventional thermal equilibrium state of an electron gas in a uniform magnetic field is generalized to the semiclassical case, the quantum case when there is no magnetic field, and the quantum case in the presence of a magnetic field, provided that only Coulomb interactions are retained. However, when the quantum gas in a magnetic field is treated with all electromagnetic interactions, at very low temperatures it becomes unstable against transverse excitations propagating in the direction of the field. This instability appears as a root of the quantum helicon dispersion relation in the upper half frequency plane. It is shown that the instability is due to the failure of the conventional Hartree ground state (in which the one-electron states are the ordinary Landau ones) to minimize the ground-state energy, when magnetic current-current interactions are retained along with Coulomb interactions. A state giving a lower energy than the conventional one, in which transverse volume currents exist perpendicular to the magnetic field was found. Because, however, the magnetic coupling is very weak, the reduction in energy is unobservably small at any realistic field strengths or electronic densities. It is concluded that the instability does not lead to any measurable effects, and that for all practical purposes the conventional thermal equilibrium state can be regarded as stable. (auth)

42189 CORRELATION ENERGY OF AN ELECTRON GAS AT METALLIC DENSITIES. M. S. Bhatia and G. Speisman (Florida State Univ., Tallahassee). Phys. Rev., 136: A362-9(Oct. 19, 1964).

A combined variational and perturbation-theoretic procedure is employed to obtain an upper limit to the ground-state energy of an electron gas at intermediate metallic densities within the accuracy of the perturbation-theory calculation of the ground-state energy. The Bohm-Pines auxiliary-variable theory of electron interactions is used. The Bohm-Pines intermediate transformation is modified so that it minimizes the ground-state energy at the intermediate stage. Further corrections are computed by perturbation theory following a procedure similar to that of Nozières and Pines. The final results for the correlation energy at intermediate densities are up to 20% lower than those of the earlier investigators. It is shown that the intermediate transformation used is an extremum for its type. (auth)

42190 MOBILITY OF IONS IN HYDROGEN. George Sinnott (Washington Univ., St. Louis). Phys. Rev., 136: A370-5(Oct. 19, 1964).

The drift velocity of positive ions in hydrogen was measured over a range of E/p_0 (ratio of electric field strength to pressure) from 0.6–110 v per cm per mm Hg by means of a double-shutter velocity spectrometer. From these data the mobility (ratio of drift velocity to electric field) at a standard gas density of 2.69×10^{19} molecules per cm^3 could be calculated. At low electric-field strengths the observed mobility was 10.2 cm per sec per v per cm at room temperature. At an E/p_0 of 10 the mobility began to rise, passing through a maximum of 14.3 at an E/p_0 of 60. The mobility at small electric field strengths was also measured as a function of temperature from 77–470°K. Its value remained nearly constant at about 10 from 77°K to room temperature and then rose abruptly to 11.5 at 375°K. These results are compared with other recent measurements, and it is suggested that H_3^+ cluster formation may be responsible for the unusual behavior of the mobility of the hydrogen ion. (auth)

42191 CORRELATIONS IN THE MOTION OF ATOMS IN LIQUID ARGON. A. Rahman (Argonne National Lab., Ill.). Phys. Rev., 136: A405-11(Oct. 19, 1964).

A system of 864 particles interacting with a Lennard-Jones potential and obeying classical equations of motion was studied on a digital computer (CDC 3600) to simulate molecular dynamics in liquid argon at 94.4°K and a density of 1.374 g cm^{-3}. The pair-correlation function and the constant of self-diffusion are found to agree well with experiment; the latter is 15% lower than the experimental value. The spectrum of the velocity autocorrelation function shows a broad maximum in the frequency region $\omega = 0.25\ (k_BT/\hbar)$. The shape of the Van Hove function $G_s(r,t)$ attains a maximum departure from a Gaussian at about $t = 3.0 \times 10^{-12}$ sec and becomes a Gaussian again at about 10^{-11} sec. The Van Hove function $G_d(r,t)$ has been compared with the convolution approximation of Vineyard, showing that this approximation gives a too rapid decay of $G_d(r,t)$ with time. A delayed-convolution approximation was suggested which gives a better fit with $G_d(r,t)$; this delayed convolution makes $G_d(r,t)$ decay as t^4 at short times and as t at long times. (auth)

42192 THEORY OF THE ABSORPTION AND EMISSION OF THE F CENTER IN ALKALI-HALIDE CRYSTALS. R. F. Wood and H. W. Joy (Oak Ridge National Lab., Tenn.). Phys. Rev., 136: A451-63(Oct. 19, 1964).

The absorption and emission processes of the F center and their relation to each other are treated using a model which contains many of the features of an exact treatment. The calculations are based on a formulation in which the total energy of the crystal in the ground and excited states is expressed as a function of the variational parameters in the F-center wave functions and of the displacements of the neighboring ions. The F electron is treated quantum-mechanically, but classical ionic crystal theory is used for all other terms in the total energy. A modified method of steepest descents is used to minimize the total energy. The electronic structure of the outer shells of the first nearest neighbor ions is taken into account in detail in the expression for the energy of the F-center electron. Simple, one-parameter, vacancy-centered wave functions are used to describe the F electron. A large Stokes shift is obtained in all crystals. The distortions are small in the ground state but, in the relaxed excited state, they are of the order of 10% of the nearest-neighbor distance and have a pronounced asymmetry. (auth)

42193 ISOTOPE SHIFT IN THE R LINES OF CHROMIUM IN RUBY AND MgO. G. F. Imbusch (Stanford Univ., Calif.), W. M. Yen, A. L. Schawlow, G. E. Devlin, and J. P. Remeika. Phys. Rev., 136: A481-6(Oct. 19, 1964).

At 4.2°K the R lines of chromium in ruby and MgO exhibit an isotope shift of 0.13 and 0.17 cm^{-1} per unit mass, respectively. This is a much larger value than is found for free atoms of intermediate mass. The possibility that this isotope shift is caused by the interaction of the ion with the vibrating lattice is considered. The ion-phonon interaction causes a frequency shift in these R lines, and this shift depends on the amplitude of vibration of the chromium ion. The lighter chromium isotopes, however, have a larger amplitude of vibration than the heavier isotopes, and consequently the frequency shift varies from isotope to isotope. This leads to an isotope shift. For the R lines of ruby and $MgO:Cr^{3+}$ the isotope shift due to the interaction with the zero-point vibrations is calculated, and is in very good agreement with the experimental values, both in magnitude and direction. (auth)

42194 TRANSIENT NUCLEAR MAGNETIC RESONANCE STUDY OF THE CONDUCTION BAND OF METALLIC Na_xWO_3: ^{23}Na RELAXATION. A. T. Fromhold, Jr., and Albert Narath (Sandia Lab., Albuquerque, N. Mex.). Phys. Rev., 136: A487-93(Oct. 19, 1964).

The spin-lattice relaxation time T_1 of the ^{23}Na nuclear magnetization in the cubic sodium–tungsten bronzes Na_xWO_3 was measured as a function of x value (0.56–0.89) and temperature (1.4–298°K). There is evidence that more than 10% of the sodium nuclei aggregate into sodium-vacancy-free (x = 1) regions. The temperature dependence of the data shows that the relaxation rate of ^{23}Na nuclei outside the vacancy-free regions is determined largely by a conduction-electron mechanism at 20 and 76°K, but that a quadrupolar mechanism becomes important at 298°K and spin diffusion to paramagnetic impurities begins to limit T_1 at 4°K. For x = 0.73, T_1T = 74 min-°K for conduction-electron relaxation, T_1 = 18 min for spin-diffusion-limited paramagnetic-impurity relaxation, and T_1 = 7.7 sec at 298°K for quadrupolar relaxation. The relaxation rate for the conduction-electron mechanism does not vary markedly with x value; the relaxation rates for the quadrupolar and paramagnetic-impurity mechanisms tend to decrease with increasing x value. The measured value of the conduction-electron contribution to the sodium nuclear relaxation is combined with an estimate of T_1 for relaxation through sodium 3p conduction electrons to give a conservative upper limit estimate of 33% for the density of sodium states at the Fermi surface. (auth)

42195 LUMINESCENT DECAY OF KI: Tl, KBr: Tl, AND KCl: Tl. Robert Illingworth (Univ. of Rochester, N. Y.). Phys. Rev., 136: A508-17(Oct. 19, 1964).

The luminescent decay of single crystals of KI: Tl excited in the A, B, C, and D absorption bands was investigated over the temperature range 10 → 300°K. A quantitative description of the decay of luminescence excited in the A band is given. Four of the emission bands have decay times consistent with the Seitz model, but the decay of the 4300-Å band does not agree with this model. Measurements of the luminescent decay of KBr: Tl and KCl: Tl excited in the A absorption band are presented, and the results are compared with those obtained for KI: Tl. The results support the hypothesis that the 3000-Å emission band in KCl: Tl at 10°K is double. (auth)

42196 NOTTINGHAM EFFECT IN FIELD AND T–F EMISSION: HEATING AND COOLING DOMAINS, AND INVERSION TEMPERATURE. F. M. Charbonnier, R. W. Strayer, L. W. Swanson, and E. E. Martin (Field Emission Corp., McMinnville, Ore.). Phys. Rev. Letters, 13: 397-401(Sept. 28, 1964).

Electron emission is accompanied by energy exchanges between the conduction electrons and the cathode lattice, which become particularly important at the very high emission densities feasible with field and T–F emission cathodes. Their study is of basic interest as it provides a complementary check, through a direct measurement of the average energy of the emitted electrons, of the theory of field and T–F emission; it is also of practical importance because these energy exchanges control the cathode tip temperature and set an upper limit on the feasible emission density. Data confirming the theoretically predicted temperature dependence of the exchange and its reversal (from cathode heating to cooling) at high temperatures are presented. (C.E.S.)

42197 SCATTERING OF BLOCH WAVES OF FAST ELECTRONS IN CRYSTALS WITH LATTICE DEFECTS. M. Wilkens (Max-Planck-Institut für Metallforschung, Stuttgart). Phys. Status Solidi, 6: 939-56(Sept. 1, 1964). (In German)

The Schrödinger equation for the diffraction of fast electrons in a distorted lattice was solved for the so-called N-beam case. The solution is represented by a sum of Bloch functions of an undistorted lattice with excitation strengths, which depend on the space coordinates. Differential equations between the excitation strengths, which can be interpreted as a scattering of Bloch waves due to the lattice distortions, are established. For the symmetric Laue case, N = 2 and column approximation, these differential equations reduce to differential equations that were derived earlier by another method. For application to problems of electronmicroscopic contrast of lattice defects, an approximate method for the solution of the differential equation is given, which allows for the conservation of particles up to quadratically small terms (for crystals without absorption). A comparison of this approximate method with numerically integrated solutions showed the usefulness of the method. The presented theory of diffraction in distorted lattices is compared with a similar theory of Kato. (auth)

42198 TEMPERATURE-DEPENDENCE OF THE TRANSPARENCY OF THIN LAYERS FOR FAST ELECTRONS. H. Boersch, O. Bostanjoglo, and H. Niedrig (Technische Universität, Berlin). Z. Physik, 180: 407-14 (1964). (In German)

With 30-kev electrons the temperature dependence of the transparencies of thin layers of Pb, Ag, Bi, PbI_2, Cu, Au, and Al was measured for temperatures between 4.6 and 770°K. Results showed a strong exponential dependence of the transparency on temperature and on layer thickness (at 400 to 1500 Å). For given layer thickness the temperature dependence of the investigated substance was less in the specified sequence. The measurement results agreed approximately with a simple calculated estimate. (tr-auth)

42199 PECULIARITIES OF A LOW-PRESSURE DISCHARGE IN PENNING TUBES. Yu. E. Kreindel and A. S. Ionov. Zh. Tekhn. Fiz., 34: 1199-1205(July 1964). (In Russian)

The behavior of ion and electron beam components at the inlet of a Penning-type tube was studied during magnetic field intensity variations. The particle distribution density was measured at various distances from the discharge axis. The discharge pictures were taken at various magnetic field intensities. (tr-auth)

42200 THE INFLUENCE OF A CONSTANT MAGNETIC FIELD ON A STATIONARY CORONA DISCHARGE. V. N. Kostin and V. M. Tkachenko (Khar'kov State Univ.). Zh. Tekhn. Fiz., 34: 1252-8(July 1964). (In Russian)

The influence of a magnetic field (H = 0 to 2300 gauss) on electric characteristics of the unipolar corona discharge at reduced hydrogen, air, and argon pressure (p = 1 to 70 mm Hg) was studied. Relations were obtained for the initial intensity, discharge current, and positive ion mobility as functions of magnetic field intensity. The principle concepts of the effect are analyzed. (tr-auth)

42201 LECTURES ON GAS THEORY. Ludwig Boltzmann. Translated by Stephen G. Bruch from Vorlesungen über Gastheorie. Berkeley and Los Angeles, University of California Press, 1964. 497p. $10.00.

The theory of gases with monatomic molecules, Van der Waals' theory, general mechanics for gas theory, gases with compound molecules, derivation of Van der Waals' equation by means of the virial concept, the theory of dissociation, and the laws of thermal equilibrium in gases with compound molecules are discussed. (C.E.S.)

42202 FIELD-COUPLED SURFACE WAVES. A COMPARATIVE STUDY OF SURFACE-COUPLED ELECTROHYDRODYNAMIC AND MAGNETOHYDRODYNAMIC SYSTEMS. James R. Melcher. Cambridge, Mass., Massachusetts Institute of Technology, 1963. 199p. $5.00.

Surface waves, which propagate along the interface between two fluids, are discussed. Fundamental equations and boundary conditions, basic waves, instability, radiation, and resonance, the planar jet, the circular electrohydrodynamic jet, electrohydrodynamic and magnetohydrodynamic surface waves, and electrohydrodynamic and magnetohydrodynamic surface shocks are considered. (C.E.S.)

42203 SPECTRAL TIME-RESOLUTION OF LIGHT FROM MICROWAVE DISCHARGES IN HELIUM. Arthur Richard Tynes. Thesis, Corvallis, Ore., Oregan State Univ., 1964. 242p.

Temporal variations in individual spectrum lines emitted by a microwave discharge in pure helium are investigated. The discharge is produced in a quartz tube located inside of a section of waveguide which carries pulsed 3-centimeter microwaves. In order to explain the variations, a theory to fit both an ideal three-level atom and an ideal six-level atom is developed. Both theories lead to a set of simultaneous differential rate equations that describe the temporal variations of the important variables including the light intensity of selected spectrum lines. Computer solutions of both sets of equations agree favorably with the experimental results. In this respect the eight rate equations which result from the six-level atom are in excellent qualitative agreement and moderately good quantitative agreement with the results of the experiment. The rate equations lead to a consistent and logical description of the plasma characteristics both during the microwave power pulse and during the afterglow that follows. It is shown that the process $He^m + He^m \rightarrow He_2^+ + e + KE$ is very important for producing the afterglow light spike and the rate equations are solved in an attempt to determine the conversion frequency for this process. This conversion frequency is estimated to be approximately 5×10^{-14} m^3/second. (Dissertation Abstr., 25: No. 1, 1964)

Accelerators

Refer also to abstracts 41906 and 42620.

42204 (BNL-8316) ALIGNMENT STABILITY OF THE 33-Bev SYNCHROTRON AT BROOKHAVEN NATIONAL LABORATORY, 1959-1963. O. S. Reading (Brookhaven National Lab., Upton, N. Y.). July 15, 1964. Contract [AT(30-2)-Gen-16]. 28p.

The AGS is stable well within its present operating tolerances. However, when major shielding load or construction changes are made in its immediate vicinity, some realignment may become desirable. Only one general and one partial realignment have been considered desirable in the four years since its construction. These realignments were accomplished without handicaps to the operation of the machine when it was shut down for other reasons. The variations in alignment observed, also some test measurements of settlements under various load conditions are summarized. (auth)

42205 (BNL-8372) OPTICAL DESIGN OF AN RF SEPARATED BEAM FOR THE BNL 80-IN. BUBBLE CHAMBER. H. Foelsche, J. Lach, J. Sandweiss (Yale

Univ., New Haven); M. Gundzik (Syracuse Univ., N. Y. and Brookhaven National Lab., Upton, N. Y.). July 22, 1964. Contract AT-30-2-GEN-16. 33p.

The development of the optical design of an r-f separated beam for $\pi^{\pm}$, $K^{\pm}$, or $\overline{p}$, to be used with the Brookhaven AGS and 80-in. bubble chamber, is reported. (R.E.U.)

42206 (CEAL-1011) SEMI-ANNUAL REPORT [ON ACCELERATORS], JANUARY 1–JUNE 30, 1964. (Cambridge Electron Accelerator, Mass.). July 21, 1964. Contract AT(30-1)-2076. 14p.

Operation and modification of the 6-Bev Cambridge Synchrotron and associated facilities are summarized. The general nature of the 15 experiments in progress are indicated. (N.W.R.)

42207 (DESY-64/4) DIE EINFANGSBEDINGUNGEN UND PHASENSCHWINGUNGEN HOHER TEILCHENSTROME IN EINEM ELEKTRONEN-SYNCHROTRON. (The Initial Conditions and Phase Oscillations of High Particle Currents in an Electron Synchrotron). C. Passow (Deutsches Elektronen-Synchrotron, Hamburg). Apr. 1964. 112p.

The phase oscillations of electrons in a synchrotron are investigated using an analog model as well as analytic methods, taking into consideration the voltages induced in the cavities by the electrons themselves (beam loading voltage). The interaction of particles and cavities is studied to an extent that exceeds the linear approximation, and it is shown that the amplitude of the oscillations and the distribution of the particles in phase space of synchrotron oscillations have a substantial effect upon the value of the beam loading voltage; the distribution also affects the number of higher-order harmonics in the beam loading voltage. The conditions for trapping the particles are calculated at comparatively large amplitudes by using a model equation in which the modulation of the beam loading voltage is neglected. The model equation contains the voltages at particle injection and in the stationary state. Voltages and phases of the stationary state are computed as a function of the synchrotron oscillation amplitude. It is shown that for insufficient generator currents the synchrotron oscillation is blown up to a limiting value by the smallest perturbation. The oscillation amplitude of the particles are adiabatically damped towards zero only when the currents are large enough to induce a voltage high compared with the beam loading voltage. The influence of detuning of the cavity is studied by using the formalism developed. (auth)

42208 (DESY-64/7) DER MAGNETISCHE INFLEKTOR. (The Magnetic Inflector). M. Swars (Deutsches Elektronen-Synchrotron, Hamburg). May 1964. 21p.

The production of a fast pulsed magnetic field for the DESY inflector is considered. Hydrogen thyratrons were used to realize these pulses. Some problems of pulse measurement and amplitude control are described in detail. (auth)

42209 (IFA-M-29) CERAMICHESKAYA USKORITEL'NAYA KAMERA DLYA BETATRONA. (A Ceramic Accelerating Chamber for the Betatron). E. Stoikovich, G. Bachu, M. Bedenoyu, N. Chentya, and S. Khal'trikh (Academia R.P.R. Institutul de Fizica Atomica, Bucharest). [1959]. 7p.

In view of the service conditions to which it is subjected, the accelerating chamber of a betatron must be constructed of a dielectric material and it must possess a toroidal shape with an elliptic cross section; in addition, provisions must be made for the necessary joints. In view of the disadvantages presented by glass and organic plastics, the chamber of a 30-Mev betatron was fabricated of a ceramic material. As the fabrication of toroid with an elliptical cross section presents serious problems, the walls of the chambers were made of a number of flat surfaces, approximating the elliptic profile; this shape was found to resist deformation sufficiently well. Glazing of the internal surface reduced the leak rate to 5×10^{-7} l torr/sec. The fabrication consisted in pouring the clay slip into the plaster form; after air-drying the body is coated internally with the glaze and is fired at 1350 to 1380°C for 32 hours. Microcracks uncovered afterwards could be satisfactorily plugged with an epoxy resin. The internal surface was chemically silver-plated in order to avoid the accumulation of charges. Soldered-on metal-ceramic seals provided the necessary connections. (TTT)

42210 (JINR-E-1805) SEPARATION METHODS FOR HIGH- AND SUPERHIGH-ENERGY PARTICLES. M. Deusch (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 28p. (CONF-550-71)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Beam separation techniques and instrumentation are described; subject papers are reviewed. (R.E.U.)

42211 (PPAD-503-E) MAGNET FOR THE PRINCETON-PENNSYLVANIA SYNCHROTRON. P. J. Reardon, L. Seidlitz, and F. C. Shoemaker (Princeton–Pennsylvania Accelerator, Princeton, N. J.). Aug. 1963. Contract AT(30-1)-2137. 25p. (CONF-550-80)

From The International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The magnet has a "C" shape with separate crenelated pole pieces and has "n" ≈ 0.6 over a useful aperture of 16.5 cm × 6.1 cm from the injection field of 270 gauss to 14 kilogauss. Each of the 16 sections weighs 40 tons. It is excited with a d-c biased sine-wave at 19 cps. The necessary magnetic field measurements were performed on a series of model magnets, and the only electrical correction required for operation is a ±0.3% magnet for adjustment of B_{min}. (auth)

42212 EXCITATION OF COAXIAL RESONATOR IN CYCLIC ACCELERATOR WAVEGUIDE. A. N. Didenko and Yu. A. Salivon (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 144-50(1964). (In Russian)

42213 RADIAL BEAM STUDIES USING AN EMULSION TECHNIQUE APPLIED TO THE CERN LINEAR ACCELERATOR. Th. Sluyters (CERN, Geneva). Nucl. Instr. Methods, 27: 301-5(July 1964).

An emittance measuring technique using emulsion detection was applied to determine proton beam qualities up to 50 Mev and beam intensities up to 300 mA per 10 μsec. The evolution of beam emittances along the linear accelerator is discussed. (auth)

42214 BACKGROUND RADIATION IN AN ENCLOSURE FOLLOWING A SHORT BURST FROM A PULSED ACCELERATOR. F. J. M. Farley and B. S. Carter (CERN, Geneva). Nucl. Instr. Methods, 28: 279-85(Aug. 1964).

The background radiation near the external target of the CERN proton synchrotron following a short burst was analyzed, attributing the delayed background primarily to neutron-capture gamma rays in equilibrium with the neutron flux in the enclosure. The results were confirmed by experimental observations. (D.C.W.)

42215 COOLING DEVICE FOR PARTICLE ACCELERATOR TARGETS. C. Dreze and H. Duquesne (Université, Liege). Nucl. Instr. Methods, 28: 321-4(Aug. 1964). (In French)

A system for cooling accelerator targets using a liquid nitrogen flow is described. A power of about 40 w was dissipated in a glass target with a surface of 0.5 cm^2 cooled by the system. (D.C.W.)

42216 ORBIT STABILITY IN A HELICALLY PERTURBED MAGNETIC FIELD. L. M. Lidsky (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 7: 1484-8 (Sept. 1964).

The stability of particle orbits in resonant helices ("corkscrews") is investigated for axial acceleration and deceleration of the injected particles. It is shown that deviations from the unperturbed orbit lead to growing oscillations about that orbit for a decelerating corkscrew. The growth rate is small in devices suitable for injection into mirror fields. The numerical results are in agreement with experimental observations of injection parameters and output properties. Deviations from the equilibrium orbit in an accelerating corkscrew lead to damped oscillations. (auth)

42217 EXPERIMENTAL STUDIES OF FOCUSING BY ACCELERATING FIELDS. A. P. Maltsev, E. A. Zotova, and V. A. Teplyakov. Pribory i Tekhn. Eksperim., No. 4, 20-3(July-Aug. 1964). (In Russian)

Experiments were performed on an electron model of a proton linear accelerator. It was shown that focusing by an accelerating field is successfully carried out as predicted by theory. (tr-auth)

42218 CALCULATIONS OF PARTICLE FOCUSING BY QUADRUPOLE LENS DOUBLETS. V. V. Miller (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 23-5(July-Aug. 1964). (In Russian)

A highly exact expression for the sum of the focal lengths of a lens ($f_+ + f_- = l/3$, where l is the effective length of the lens) is used for the analytic calculation of focusing by a doublet of quadrupole lenses. Assuming that the main planes of the lens coincide with its center, it is easy to obtain the quadratic equation for finding f_1 and f_2. The method of calculation gives accuracy better than 1% even for $l/f \gtrsim 0.5$. A method is shown for introducing corrections for the noncoincidence of the main planes with the lens center. (tr-auth)

42219 CONTROL OF PARTICLE BEAM MOTION IN ACCELERATORS. K. N. Shorin (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 25-7(July-Aug. 1964). (In Russian)

A method is described for beam control in accelerators. The method was used in the 0.7 Bev FIAN synchrotron to refine the currents of compensating magnets. The use of data obtained by this method decreased particle losses during acceleration to one tenth their previous levels. (tr-auth)

42220 CONSTRUCTION AND CHARACTERISTICS OF 5-Mev MICROTRON. B. Z. Kanter and Yu. G. Yushkov. Pribory i Tekhn. Eksperim., No. 4, 28-31(July-Aug. 1964). (In Russian)

Results of reconstruction work on the Tomsk Polytechnical Institute 5-Mev microtron with toroidal accelerating resonator and thermoautocathode for injector are presented. The design of the electromagnet, vacuum chamber, and high-frequency system of the microtron is described, and the adjustment and operation are discussed. (M.J.T.)

42221 FOCUSING OF DEFLECTED CYCLOTRON BEAM BY A MAGNETIC CHANNEL. V. R. Belov, Yu. S. Popov, and L. S. Sokolov (Scientific-Research Inst. of Nuclear Physics, Electronics and Automatics, [Academy of Sciences, USSR]). Pribory i Tekhn. Eksperim., No. 4, 37-8(July-Aug. 1964). (In Russian)

The focusing is performed by two steel wedges placed symmetrically, relative to the median plane of the accelerator, and forming a magnetic field which increases with radius. Photographs of the tracks of a 12.8-Mev molecular H ion beam leaving the accelerator are given, with and without the focusing channel. (M.J.T.)

42222 MURA 50-Mev ELECTRON ACCELERATOR. I. GENERAL DESCRIPTION AND REVIEW. F. T. Cole, G. Parzen, C. H. Pruett, W. A. Wallenmeyer, and D. E. Young (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1393-7(Nov. 1964).

General descriptions of the history, construction, and operation of the MURA 50-Mev electron accelerator are given. In its operation, this accelerator was used to stack large circulating currents of accelerated particles and to investigate multiturn injection, acceleration processes, resonant effects, and collective instabilities. (auth)

42223 MURA 50-Mev ELECTRON ACCELERATOR. II. DESIGN STUDY AND CHOICE OF OPERATING POINT. F. T. Cole, R. O. Haxby, A. M. Sessler, and J. N. Snyder (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1398-1401(Nov. 1964).

The design study which led to the MURA 50-Mev electron accelerator is described. Choice of accelerator type, energy and operating point, computer studies, tolerances to field errors, and design of the shaped pole are discussed. (auth)

42224 MURA 50-Mev ELECTRON ACCELERATOR. III. DESIGN AND CONSTRUCTION OF THE MAGNETS AND MAGNET SUPPORT STRUCTURE. R. O. Haxby, E. A. Day, J. R. Mulady, C. H. Pruett, W. A. Wallenmeyer, and W. R. Winter (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1402-8(Nov. 1964).

Design and construction of the magnets and magnet support structure of the MURA 50-Mev electron accelerator are discussed. The choice of the basic magnet structure as determined by the accelerator parameters and methods of matching the magnets and winding the coils to produce magnets with uniform properties are described. (auth)

42225 MURA 50-Mev ELECTRON ACCELERATOR. IV. MAIN MAGNET POWER SUPPLIES. Martin M. Bernd (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1409-15(Nov. 1964).

The main magnet power supplies for the MURA 50-Mev electron accelerator consist of motor generator sets for producing the direct current, a transistor filter in series with the load to absorb transients, and a high gain regulator to provide long term stability. Two 70-A, 50-kw power supplies with stability of 0.002% and two 14-A, 4-kw power supplies of 0.01% stability are required. In addition, it is necessary to be able to turn the supplies on slowly, reproducibly, and with a minimum of overshoot. (auth)

42226 MURA 50-Mev ELECTRON ACCELERATOR. V. TOLERANCES AND EFFECTS OF FIELD PERTURBA-

TIONS. G. Parzen (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1415-21 (Nov. 1964).

The operating point of the MURA 50-Mev electron accelerator lies near three linear perturbation resonances. The effect of each of these resonances is examined and the tolerances due to each resonance are determined. Results are also given for the effects of perturbations at the two-way operating point. (auth)

42227 MURA 50-Mev ELECTRON ACCELERATOR. VI. MAGNETIC GUIDE FIELD MEASUREMENTS AND CORRECTIONS. C. H. Pruett, R. S. Christian, G. del Castillo, R. O. Haxby, J. R. Mulady, R. A. Otte, G. Parzen, W. A. Wallenmeyer, and D. E. Young (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1422-36(Nov. 1964).

Methods of measurement and correction of the magnetic fields of the MURA 50-Mev electron accelerator are described. Measurements of the vertical and horizontal field components were made and the field errors corrected. Correction coils, iron shims, and adjustment of magnet positions were used to produce fields within the required tolerances. Computer methods were used to calculate needed corrections and to evaluate the quality of the corrections achieved. (auth)

42228 MURA 50-Mev ELECTRON ACCELERATOR. VII. EQUIPMENT AND PROCEDURES USED IN MAGNETIC FIELD MEASUREMENTS. J. R. Mulady, G. E. Bush, R. O. Haxby, C. H. Pruett, and W. A. Wallenmeyer (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1437-44(Nov. 1964).

Magnetic field measuring equipment and procedures used in measuring the magnetic guide field of the MURA 50-Mev electron accelerator are described. Systems for measuring the field gradient index and the vertical, radial, and azimuthal components of the field on the median plane are considered. Methods of using these systems to attain field measurement accuracies of the order of 0.1% in a very inhomogeneous field ranging in magnitude from 20 to 5000 G are discussed. (auth)

42229 MURA 50-Mev ELECTRON ACCELERATOR. VIII. VACUUM SYSTEM. C. W. Owen, G. M. Lee, and J. N. McGruer (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1444-6(Nov. 1964).

Details of the design, fabrication, and assembly, and operating experience are given for the vacuum system of the MURA 50-Mev electron accelerator. A vacuum envelope constructed of $^3/_8$-in.-thick aluminum alloy is evacuated to pressures of the order of 10^{-7} torr by two 280-liter/sec getter-ion pumps. Viton-A elastomer gaskets are used throughout for both fixed and sliding seals. (auth)

42230 MURA 50-Mev ELECTRON ACCELERATOR. IX. INJECTOR. C. D. Curtis, F. E. Mills, R. S. Christian, G. M. Lee, C. A. Radmer, M. F. Shea, and D. A. Swenson (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1447-51(Nov. 1964).

An electron gun and an inflection system which satisfy the injection requirements of the MURA 50-Mev electron accelerator are described. Electrons emitted from a tungsten ribbon filament are accelerated to 100 kev by a converging radial field of cylindrical geometry and deflected parallel to the equilibrium orbit of the accelerator by a 60° electrostatic inflector. The inflector also provides focusing of both the radial and vertical motion of the beam. The gun and inflector are located within the guide field region of the magnets and are adjustable in position as a unit. The emittances of the system are 0.5 and 1.0 π mrad-cm for the horizontal and vertical motions, respectively. Although the injector is capable of delivering several hundred millamperes, it is normally operated at much lower currents since fewer than 20 mamp are required to reach the space-charge limit of the accelerator when multiturn injection techniques are employed. (auth)

42231 MURA 50-Mev ELECTRON ACCELERATOR. X. MULTITURN INJECTION TECHNIQUES. F. E. Mills, C. D. Curtis, F. L. Peterson, C. A. Radmer, M. F. Shea, D. A. Swenson, and D. E. Young (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1451-8(Nov. 1964).

Multiturn injection techniques employed in the MURA 50-Mev electron accelerator are described, together with an evaluation of their performance. These include shifting of the equilibrium orbit by a time-varying bump, damping of betatron oscillation amplitudes by an r-f voltage, and damping of amplitudes by space-charge effects. Multiturn injection is achieved by filling the accelerator radial phase space with injected beam. The capture of injected charge approaches 100% when the programmed field bump is used. This high efficiency was achieved for about 15 turns of total beam from the inflector and for about 40 turns of collimated beam. Injection at the higher beam intensities gives rise to spontaneous longitudinal bunching of the circulating beam for all energies from injection to above transition with the magnitude generally greatest just above transition. (auth)

42232 MURA 50-Mev ELECTRON ACCELERATOR. XI. RADIOFREQUENCY ACCELERATION SYSTEM. THEORETICAL CONSIDERATIONS AND DESCRIPTION. K. R. Symon, E. M. Rowe, D. A. Swenson, and L. H. Johnston (Midwestern Universites Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1459-66(Nov. 1964).

Theoretical considerations pertinent to the design of the radio-frequency acceleration system for the MURA 50-Mev electron accelerator are presented. Parameters of the acceleration system are developed on the basis of these considerations. Theoretical limitations of the maximum stacked beam obtainable with this acceleration system are given. (auth)

42233 MURA 50-Mev ELECTRON ACCELERATOR. XII. BETATRON ACCELERATION. F. L. Peterson and C. A. Radmer (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1467-9(Nov. 1964).

Four transformer cores symmetrically placed around the FFAG electron accelerator are used to accelerate particles from an injection energy of approximately 100 kev to about 2 Mev, which is well above the transition energy of 1.13 Mev. This type of acceleration during the early part of the operating cycle provides flexibility and simplification for the injection process, eliminates the complications required by an r-f program suitable for accelerating particles through the transition energy, and is a useful analyzing tool for certain types of experiments. Detailed operation of the betatron system and its associated components is described. The construction parameters of the cores and a description of the associated pulsed power supply and integrator circuits are also discussed. (auth)

42234 MURA 50-Mev ELECTRON ACCELERATOR. XIII. RADIO-FREQUENCY ACCELERATION SYSTEM. DESIGN AND CONSTRUCTION. E. M. Rowe, R. H. Hilden, R. F. Stump, and D. A. Swenson (Midwestern Universities

Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1470-7(Nov. 1964).

The design, construction, and operation of the accelerating and holding r-f systems of the MURA 50-Mev electron accelerator are described and discussed. Qualitative results of experiments with the systems are given. (auth)

42235 MURA 50-Mev ELECTRON ACCELERATOR. XIV. CONTROL AND PROTECTION SYSTEMS. F. L. Peterson and C. A. Radmer (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1478-80(Nov. 1964).

The control system for the MURA 50-Mev electron accelerator is designed for maximum versatility consistent with ease of operation and personnel and component protection. Since the purpose of this project is to study many different accelerator phenomena, and the accelerator is capable of producing intense background radiation, it must be capable of functioning in several modes of operation and observation with adequate safety precautions. In addition to the flexible injection, acceleration, and beam stacking controls, accurate probe positioning devices are needed for detailed analysis of beam characteristics. Numerous limiting interlocks on various components and systems are also necessary because of the extremely tight tolerances involved. A description of some of the major control elements is presented and the overall system described. (auth)

42236 MURA 50-Mev ELECTRON ACCELERATOR. XV. BEAM MEASUREMENT PROBES. G. M. Lee, J. N. McGruer, F. E. Mills, G. W. Owen, F. L. Peterson, C. A. Radmer, E. M. Rowe, and D. A. Swenson (Midwestern Universities Research Assn., Stoughton, Wis.). Rev. Sci. Instr., 35: 1480-2(Nov. 1964).

The design and construction of probes to measure beam size, orbit shape, betatron oscillation frequencies, and beam intensity are described, together with the mechanical and electrical aspects of the probe drives which move the probes. (auth)

42237 ELECTRONIC SERVO FOR SYNCHROTRON INJECTION TIME CONTROL. C. P. Wang (Cornell Univ., Ithaca, N. Y.). Rev. Sci. Instr., 35: 1492-3(Nov. 1964).

An electronic servo was developed for injection time control of an electron synchrotron. It consists of a delay time command, an error detector, an integrator, an adder, a variable time delay unit, and a time-to-pulse-height converter. The servo works with electric potential analog and contains no mechanical movable parts except the delay time command Helipot. Timing errors of the controlled system (the thyratron pulsing the synchrotron injector, together with its trigger circuit) are converted into error voltage pulses and applied to the time delay unit for self-correction. The time-height converter is sensitive to better than 1 part in 5000. This and the double-forward-path control introduced make the regulated output extend from 3.5 to 8.5 μsec, with 0 nsec error for steady timing errors in the controlled system and 10 nsec error for random fluctuations. The servo was built with transistors and was temperature compensated. The temperature stability is better than 5 nsec/°C. (auth)

42238 TEMPERATURE COMPENSATION OF TRANSISTOR INTEGRATOR. C. P. Wang (Cornell Univ., Ithaca, N. Y.). Rev. Sci. Instr., 35: 1493-4(Nov. 1964).

That the temperature dependence of $(I_{CEO})_{inverted}$ of an inverted transistor can be very effectively used for temperature compensation is shown. Conditions were derived for complete compensation of an integrator amplifier with emitter follower output and single-stage amplifier. Both compensations were used in the integrator unit incorporated in a delay time electronic servo, giving a temperature stability of better than 0.01 v/°C at the integrator output, or better than 5 nsec/°C at the servo output. Smaller drift can be achieved, if desired, with more careful choice of transistor types and transistors for compensation. (auth)

42239 REFLECTION PROPERTIES OF DEFLECTING MAGNET SYSTEMS. E. E. Bliamptis (High Voltage Engineering Corp., Burlington, Mass.). Rev. Sci. Instr., 35: 1521-2(Nov. 1964).

Certain properties of mirror symmetric magnet deflection systems are derived. By suitable choice of parameters, such as the radii, angles of deflection, angles of incidence, and component separations, a magnet system may be designed which, to first order, is achromatic, nondispersive, and has high resolving power. The resulting constraints are given in terms of the matrix elements of the first half of the deflection system. (auth)

42240 SELF-SUPPORTING CALCIUM, POTASSIUM, AND LITHIUM TARGETS. Stephen H. Maxman (Univ. of Pennsylvania, Philadelphia). Rev. Sci. Instr., 35: 1572-3 (Nov. 1964).

The methods of vacuum evaporation of calcium, potassium, and lithium are discussed for the production of self-supporting targets in the thickness range of ~100 to 1500 $\mu g/cm^2$. (auth)

42241 EFFECTS OF THE X-RAY BACKGROUND IN THE ELECTRON RADIATION OF A 35-Mev BETATRON. Dietrich Frost and Klaus Wuerthner (Rudolf-Virchow-Krankenhauses, Berlin). Strahlentherapie, 124: 513-19 (Aug. 1964). (In German)

The fraction of x rays in the electron radiation of the Berlin 35-Mev betatron is reported. In case of 36.1 Mev the x-ray portion is a little over 2% of the total radiation and increases by a factor 10 with decreasing extraction field intensity. This increase can be avoided, if always a high extraction field intensity is used. This is possible throughout the energy range and also very useful because maximal dose rates can be achieved. Only in case of 25 Mev an increased x-ray portion of 8 and 10%, respectively, depending on the location, cannot be avoided. (auth)

42242 ACCELERATION OF ELECTRONS IN A PLASMA BETATRON. J. Drees and W. Paul (Universität, Bonn). Z. Physik. 180: 340-61(1964). (In German)

A plasma was produced by a high-frequency electric quadrupole field (200 Mc) at gas pressures of 10^{-4} to 5×10^{-3} mm Hg in a quartz glass torus. The torus was placed between the poles of an air-core betatron with the following properties: radius of equilibrium orbit 20 cm, maximum accelerating field strength 80 v/cm, end energy 1.5 Mev. Associated with conduction currents of some 100 amp, energetic bremsstrahlung was observed and attributed to 1.2-Mev electrons. The number of accelerated electrons was of the order of 10^{11} per pulse. The intensity and energy of the radiation, together with the time dependence of the plasma current, were observed as function of different parameters, such as the gas pressure, high-frequency amplitude, and induced acceleration field strength, for different gases. The energetic radiation disappears when, because of the self-induced magnetic field, the stability condition for the betatron equilibrium is no longer fulfilled. (auth)

42243 INVESTIGATIONS OF ACCELERATING SYSTEM IN AN H_{111}-WAVE. V. A. Bomko and E. I. Revutskii. Zh. Tekhn. Fiz., 34: 1259-65(July 1964). (In Russian)

Investigations were made of a H_{111}-type system with the drift tubes attached separately, one after another, on the opposite sides of a resonator cylinder retaining the separate tube sections. The model is used for determining the absolute magnitude of the resonator proper frequency which is developed by the acceleration system, the resonator frequency dependence on the type of load, the proper resonator frequencies as functions of the length and diameter at various acceleration periods, the adjustment of resonator separation sections and the distribution of fields along the acceleration systems, the shunting resistance of various accelerating system parameters, and the variation of the parameters during actual operation. (R.V.J.)

42244 HIGH-FREQUENCY CHARACTERISTICS OF AN ACCELERATOR FOR MULTICHARGED IONS WITH ENERGY TO 1 Mev PER NUCLEON ON A H_{111} WAVE. V. A. Bomko, E. I. Revutskii, and L. A. Bolotin. Zh. Tekhn. Fiz., 34: 1266-71(July 1964). (In Russian)

A 1-Mev nucleon accelerator using a H_{111} wave type acceleration system is described. The H_{111} type acceleration system, with considerably smaller installation cross sections, has a long critical wave. The resonator proper frequency is 50.1 m Hertz, which coincides with the theoretical value. The system constructed for 6 m wavelength has high shunting resistance which is about 4 times higher than that for the E_{010} system for the same wavelength. (R.V.J.)

42245 HIGH-FREQUENCY ACCELERATOR-RESONATOR FOR 1-Mev PROTONS. A. A. Glazov, V. A. Kochkin, D. L. Novikov, and L. M. Onishchenko. Zh. Tekhn. Fiz., 34: 1272-84(July 1964). (In Russian)

A proton injector for a ring synchrocyclotron developed by the Joint Inst. for Nuclear Research is described. The proton acceleration takes place in a resonator cavity excited with 600 m Hertz frequency. An ion source with a cold cathode and Penning-type discharge was used as the proton source. The injector produces 20 μsec pulses with proton current of 10 ma and up to 50 Hertz frequency. (R.V.J.)

42246 EXPERIMENTAL INVESTIGATION OF ION-OPTICAL PROPERTIES OF ELECTROSTATIC ANALYZER WITH A LINEAR POTENTIAL ON ELECTRODES. V. V. Zashkvara and M. I. Korsunskii (Khar'kov Polytechnic Inst.). Zh. Tekhn. Fiz., 34: 1285-92(July 1964). (In Russian)

Experimental studies were made of the ion-optical properties of an electrostatic analyzer with linearly distributed potential on deflecting electrodes. It is shown that the ion-optical properties can be controlled separately. It is also shown that a selection of corresponding potential values increased the dispersion of the electrostatic analyzer with a simultaneous increase of the resolving power. (R.V.J.)

42247 ION-FOCUSING EFFECT IN VELOCITY-MODULATED ELECTRON BEAMS. N. S. Zinchenko and B. A. Zhigailo. Zh. Tekhn. Fiz., 34: 1306-11(July 1964). (In Russian)

The focusing effect of low-voltage modulated beams with large modulation coefficients is described. Narrow modulated beams were developed, and the ion focusing mechanism produced by nonlinear shock ionization was analyzed. (tr-auth)

42248 ELECTRON TRAJECTORY ANALYSIS AND BEAM CONFINEMENT IN A LINEAR ACCELERATOR. Gene Jordan Lang. Thesis, Gainesville, Fla., Univ. of Florida, 1963. 137p.

Equations describing the electromagnetic fields in a uniform, disk-loaded waveguide structure were derived. These equations include the effects of space harmonics and attenuation. Also, equations were developed for calculating the three-dimensional motion of electrons with relativistic velocities. These equations of motion are applicable to any device in which the electromagnetic fields can be expressed in cylindrical coordinates. A computer program was written in FORTRAN language that can be used to calculate the time-varying fields in a disk-loaded waveguide excited in the $\pi/2$ mode and to solve the equations of motion. Provisions are made to utilize measured values of the static magnetic fields from specified focusing devices or the fields from localized focusing structures. As a result of studies using this program, it is seen that the focusing properties of the magnet constructed for the University of Florida linear accelerator can be improved by minor modification. It is shown that the beam parameters at the point of entrance into the disk-loaded waveguide have a marked effect on the trajectories. Results indicate that the beam characteristics can be significantly improved by limiting the beam radius at the point of injection and by incorporating a phase bunching device in the accelerator system. In a relatively short accelerator, the electron acceptance and energy are shown to be increased significantly by decreasing the phase velocity of the fundamental component of the wave from the velocity of light to a value significantly lower than the velocity of the electrons leaving the machine. (Dissertation Abstr., 25: No. 1, 1964)

42249 THE EFFECTS OF SPACE HARMONICS AND ATTENUATION ON LONGITUDINAL ELECTRON MOTION IN A LINEAR ACCELERATOR. Donald Francis Mooney. Thesis, Gainesville, Fla., Univ. of Florida, 1963. 106p.

A solution is developed for the axial field component in a disk-loaded circular waveguide type traveling wave structure and the conventional equations governing longitudinal motion in a sinusoidal field distribution are derived. The solution for the axial field component is then modified to account for the existence of space harmonics and structure attenuation and new equations of longitudinal motion are derived including these factors. A generalized computer program is developed, which is capable of calculating electron phase angle and energy versus distance in the type of disk-loaded circular waveguide structures generally used in linear accelerator applications. This program is capable of making these computations for electrons traveling on-axis or for electrons traveling off-axis at a constant radial displacement. A traveling wave prebuncher and a uniform section of accelerator are analyzed by both the conventional method of analysis and the more precise method developed here. Phase angle and energy versus distance computations are conducted for electrons traveling on-axis and also for electrons traveling at two different radial displacements. Results of computations made using the space harmonic analysis differ significantly from the results obtained from the conventional (nonharmonic) analysis. These differences indicate that in a traveling wave prebuncher the effect of space harmonics and radial trajectory displacement is a change in the structure length necessary for optimum electron bunching from that computed by the conventional method. In a uniform section of accelerator structures the effect of space harmonics and attenuation is a reduction in the electron energy from the value computed by the conventional method. (Dissertation Abstr., 25: No. 1, 1964)

42250 NOISE IN MULTI-DIMENSIONAL ELECTRON STREAMS. Cheng Paul Wen. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1963. 214p.

The noise transport and reduction phenomena in multivelocity electron beams with significant potential variations in the transverse direction were studied. Correlations between the noise reduction mechanism and the multidimensional nature of the electron beams were sought. The investigation was carried out by means of a high-speed digital computer employing two different numerical methods. Details of the derivation of a small-signal linearized Boltzmann equation in terms of a statistical electron density function and the electric field in a two-dimensional space-charge-limited diode are presented. Haus's noise theory for small-signal longitudinal beam devices is employed to evaluate the noise transport characteristics of the two-dimensional electron beam. In parallel with the density function analysis, the transport phenomena in a two-dimensional diode are treated with the Monte Carlo technique in which random numbers are generated to simulate the stochastic emission process and each electron emitted from the thermionic cathode is traced in phase space by numerical integration methods. Results from the density function calculations are presented. No reduction from the thermionic emission shot noise is observed, nor is there any evidence of the multi-dimensional noise reduction effects expected. Substantial noise reduction at low frequencies for the two-dimensional diode is found by means of the Monte Carlo calculations. A minimum noise figure of less than 2 db is predicted for 0-type devices. The reduction in beam noise is believed to be a result of the large II/S ratio developed in the extended multivelocity region created by the two-dimensional space-charge effects. The large discrepancy between the results from the two numerical methods of noise transport calculations in two-dimensional diodes of identical d-c characteristics pointed out the extreme importance of the coupling mechanism approximations. (A.G.W.)

42251 BEAM CONTROL FOR THE ACCELERATOR PROGRAM (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1146)

Drawings (20) are presented for beam control mechanisms used with 3-Mev, 5-Mev, and Tandem Van de Graaff accelerators, including tubes, viewers, slits, clippers, cups, cold traps, strippers, pulse pickups, and deflectors. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

42252 MYLAR FLASK (Engineering Materials). (California. Univ., Berkeley. Lawrence Radiation Lab.). (CAPE-1151)

Drawings (2) are presented of a container for a liquid-hydrogen accelerator target. The flask walls are of 5-mil Mylar sheet, and the domes of the flask are formed in a mold under a combination of heat and pressure. Individual titles are given in the Engineering Materials List (TID-4100). (D.C.W.)

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Refer also to abstracts 42539 and 42549.

42253 (JINR-E-1752) ON THE POSSIBILITY OF NEUTRINO ATMOSPHERES OF CELESTIAL BODIES. M. A. Markov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 6p.

In the case of a nonzero neutrino rest mass, there exists a gravitational mechanism of accumulating neutrinos around celestial bodies (formation of neutrino atmospheres). Some characteristics of such a neutrino state of matter are given. (auth)

42254 (TID-21105) A CONSIDERATION OF THE SUBSURFACE MAGNETIC FIELD OF THE SUN AND SOME CONSEQUENCES OF A TIME VARIATION. Final Report. Richard W. Hales, Clayne M. Yeates, A. Neal de Gaston, H. Mark Nelson, and R. Kenneth Walter (Brigham Young Univ., Provo, Utah). Aug. 1964. Contract AT(04-3)-461. 33p.

The preparation and information gathering for studies of a time variation of the flux tube configuration and its possible effects on the stability of the magnetic flux loops above the photosphere are discussed. The buoyancy of magnetic flux ropes on the sun was studied to reveal acceleration mechanisms that could explain some of the energies released in flares. An extensive bibliography is included. (R.E.U.)

42255 GRAVITATIONAL COLLAPSE TO A SMALL VOLUME. G. C. McVittie (Univ. of Illinois, Urbana). Astrophys. J., 140: 401-16(Aug. 15, 1964).

The theory of a collapse of a spherically symmetric mass to a configuration of very small radius is reviewed and extended. General relativity and Newtonian hydrodynamics are employed in turn. It is shown that the zero-pressure motions of collapse are deducible from both theories. Such motions are shown to be adiabatic in the Newtonian case. When the pressure is uniform but nonzero, the general relativity solution of the problem is incomplete. It is conjectured, by an appeal to the Newtonian case, that the reason lies in the non-adiabatic nature of the classical motion. The Newtonian motions can be worked out for the homologous contraction of complete polytropes, the motions again being non-adiabatic in general. Throughout the investigation, no limit is set on the magnitude of the velocity of collapse, but it is assumed that all motions obey the linear-wave velocity rule. (auth)

42256 THE DYNAMICAL INSTABILITY OF GASEOUS MASSES APPROACHING THE SCHWARZSCHILD LIMIT IN GENERAL RELATIVITY. S. Chandrasekhar (Univ. of Chicago). Astrophys. J., 140: 417-33(Aug. 15, 1964).

The theory of the infinitesimal, baryon-number conserving, adiabatic, radial oscillations of a gas sphere is developed in the framework of general relativity. A variational base for determining the characteristic frequencies of oscillation is established. It provides a convenient method for obtaining sufficient conditions for the occurrence of dynamical instability. The principal result of the analysis is the demonstration that the Newtonian lower limit $^4/_3$, for the ratio of the specific heats γ, for insuring dynamical stability is increased by effects arising from general relativity; indeed, is increased to an extent that, so long as γ is finite, dynamical instability will intervene before a mass contracts to the limiting radius ($\geq 2.25\ GM/c^2$) compatible with hydrostatic equilibrium. Moreover, if γ should exceed $^4/_3$ only by a small amount, then dynamical instability will occur if the mass should contract to the radius $R_c = (K/\gamma - {}^4/_3)(2GM/c^2)$, $(\gamma \to {}^4/_3)$, where K is a constant depending, principally, on the density distribution in the configuration. The value of the constant K is explicitly evaluated for the homogeneous sphere of constant energy density and the polytropes of indices n = 1, 2, and 3. (auth)

42257 NEUTRON STARS AS X-RAY SOURCES. Donald C. Morton (Princeton Univ., N. J.). Astrophys. J., 140: 460-9(Aug. 15, 1964).

Neutron stars are considered as the origin of the x-ray emission from Scorpius and the Crab Nebula. For a sequence of interior temperatures from 2×10^9 to 2×10^7°K, a simple, analytic model atmosphere is fitted to a typical degenerate neutron core with mass 1.3 $M_\odot$ and radius 9.25 km. Opacity from either electron scattering or bound-free absorption reduces the effective surface temperature to 1.6×10^7 to 7.7×10^5°K. Except for the coolest models, the predicted x-ray luminosities are high enough to explain the observed Scorpius flux with a neutron star 1200 to 100 pc distant. Thermal calculations show that a neutron star at these distances can remain a detectable source for a few thousand years at most. The data for the Crab Nebula indicate that it began its thermal history with a core temperature of 5.0×10^8°K and that it has now cooled to 2.3×10^8°K with an effective temperature of 7.6×10^6°K. During the past two thousand years Chinese, Japanese, and Arab astronomers have recorded five new stars in the vicinity of the Scorpius source. One of these might have been a supernova and have left a neutron star remnant. (auth)

42258 SUPERNOVA SHELLS AND GALACTIC X-RAYS. Carl Heiles (Princeton Univ., N. J.). Astrophys. J., 140: 470-6(Aug. 15, 1964).

Radiation processes must be included in the treatment of the expanding shock front caused by a supernova explosion. This result differs from that of Shklovskii, who neglected radiation by collisional excitation of atoms other than hydrogen. For a typical Type II supernova, expanding into an interstellar gas with a density of one atom per cm^3, radiation by O VIII ions will cool the exploding shell appreciably when the radius of the exploding shell is 30 pc. Type II supernova shells emit x-rays by the mechanism of free-free emission in sufficient quantity to explain one of the two sources observed by Friedman; other expected observable properties of such objects are listed. (auth)

42259 HELIUM CONTENT AND NEUTRINO FLUXES IN SOLAR MODELS. R. L. Sears (California Inst. of Tech., Pasadena). Astrophys. J., 140: 477-84(Aug. 15, 1964).

A variety of evolutionary sequences of models for the solar interior was computed, corresponding to variations in input data, to obtain some idea of the uncertainties involved in predicting a solar neutrino flux. It is concluded that the neutrino flux can be estimated to within a factor of 2, the primary uncertainty being the initial homogeneous solar composition; detailed results are given. With a preferred value of the heavy-element-to-hydrogen ratio $Z/X = 0.028$, the helium content necessary to fit a model to the observed solar luminosity is found to be $Y = 0.27$. (auth)

42260 EQUILIBRIUM MODELS FOR HELIUM-BURNING STARS. III. SEMI-DEGENERATE STARS OF SMALL MASS. John P. Cox (Univ. of Colorado, Boulder) and Edwin E. Salpeter. Astrophys. J., 140: 485-98(Aug. 15, 1964).

Equilibrium models are constructed for pure helium-burning stars of small mass. Effects of nonrelativistic electron degeneracy on the equation of state and electron thermal conduction on the opacity are included in the calculations. It is found that, for a star of given mass M, the central temperature attains a maximum value $T_{c, max}$ when the central density is a few times lower than that of a zero-temperature white-dwarf star of the same mass. A lower mass limit M_{min} of about 0.35 $M_\odot$ is derived for pure helium-burning stars. Properties of helium-burning stars with M near M_{min} are discussed, as is their evolution toward the white-dwarf stage. The early evolution of the models away from the initial helium-burning main sequence was approximately followed to the stage where the mass fraction of helium in the convective core was reduced to 10 per cent. In agreement with results obtained by Aller, the models are found to evolve upward, roughly along the helium-burning main sequence itself. (auth)

42261 EQUILIBRIUM MODELS FOR HELIUM-BURNING STARS. IV. MASSIVE STARS AND NUCLEAR ABUNDANCES. W. Deinzer and E. E. Salpeter (Cornell Univ., Ithaca, N. Y.). Astrophys. J., 140: 499-509(Aug. 15, 1964).

Equilibrium models are constructed for pure helium-burning stars of large mass M, where radiation pressure is important. The approach of extremely massive models to fully convective polytropes with n = 3 is discussed. The early evolution of the models from the initial helium-burning main sequence was followed till the mass fraction x_a of helium in the convective core is 0.02. The abundances of ^{12}C, ^{16}O, ^{20}Ne, and ^{24}Mg as a function of x_a were calculated for different masses M. The main final products are C and O for $M \lesssim 4$ (in solar units), O for $M \sim 10$ to 100, and Mg for $M \sim 10^3$ to 10^5. The final abundance of Ne is fairly small for all masses. When x_a is small, the energy production is largely from (a, γ) reactions and enhancement factors for the rate ϵ (over that for the triple-alpha reaction alone) are presented. (auth)

42262 EVOLUTION OF O STARS. II. HYDROGEN EXHAUSTION AND GRAVITATIONAL CONTRACTION. Richard Stothers (Goddard Inst. for Space Studies, New York). Astrophys. J., 140: 510-23(Aug. 15, 1964).

The evolution of a star of 30 $M_\odot$ is considered from the end of the stable phase of hydrogen burning to the onset of helium burning. Ten models are constructed for the hydrogen-exhaustion (E) phase, and six models for the gravitational contraction (G) phase. The time scale of the E-phase is so short (8.8×10^4 years) that the shell source remains peaked at q = 0.34 and undergoes little hydrogen depletion. Because radiation pressure remains strong in the core, convection does not vanish when the hydrogen content at the center falls to zero. Gravitational contraction of the core contributes more to the luminosity than shell burning, but since the total luminosity changes little, the structure of the envelope is hardly affected. On the H-R diagram, the evolutionary track turns back toward the main sequence when $X_c = 0.03$, and does not turn away again until the shell source becomes important. The G-phase begins when $L_{H, core}/L < 0.001$, and lasts 9×10^3 years. Although the temperature in the shell increases, hydrogen depletion remains negligible because of the short time scale. However, the shell narrows considerably and its peak moves slightly inward for a while. The steep temperature gradient outside the shell causes the semi-convective zone to move inward to q = 0.48; the hydrogen discontinuity attains a value $\Delta X = 0.1$. As the luminosity and radiation pressure in the shell simultaneously increase, the envelope expands. The shell then behaves like a node, since the core continues to contact. The convective region near the center shrinks asymptotically to a value q = 0.06, but at no time does the core approach an isothermal condition. The gravitational energy release is nearly uniform throughout the core in all phases. At the onset of helium burning, $T_c = 1.5 \times 10^8$°K and $\rho_c = 270$ gm/cm^3. Because of the brightening shell source, the stellar radius increases rapidly, burning the evolutionary track to completion of the typical S-shaped curve on the H-R diagram. When helium starts to burn, the spectral type is B3, and the star is expected never to return to the region of O stars during its active life. (auth)

42263 AN APPLICATION OF HENYEY'S APPROACH TO THE INTEGRATION OF THE EQUATIONS OF STELLAR STRUCTURE. R. B. Larson and P. R. Demarque (Univ. of Toronto). Astrophys. J., 140: 524-40(Aug. 15, 1964).

A method is described for the numerical solution of the equations of stellar structure by a technique especially designed for the solution of boundary-value problems. The numerical solution incorporates the boundary conditions from the start and eliminates the necessity for the trial-and-error calculations involved in many previous methods. Model-atmosphere calculations and mixing-length theory can readily be incorporated for accurate treatment of convective envelopes, and the method is capable of treating more or less exactly the energy generation and opacity laws and the equation of state for partial degeneracy. In addition, the method is well suited for the computation of evolutionary sequences of models. The method was successfully used for a number of purposes, including the computation of evolutionary tracks from the main sequence for the purpose of estimating the ages of old star clusters. (auth)

42264 SOME PROPERTIES OF SYNCHROTRON RADIATION AT OPTICAL ENERGIES. Jesse L. Greenstein (Carnegie Institution of Washington, D. C. and California Inst. of Tech., Pasadena). Astrophys. J., 140: 666-72 (Aug. 15, 1964).

For a power-law distribution of relativistic electrons, as a function of the spectral index, various properties of the energy, J_ν, contained within certain ranges of optical frequency, and the cutoff frequency, ν_c, are given. The ultraviolet energy available for hydrogen ionization in associated gaseous nebulae proved to be appreciable for $\nu_c = 10^{15}$ sec^{-1}; the particle distribution requires an ultraviolet higher-energy electron tail for ions of higher ionization potential. Such a tail will not require excessively high energy content, or produce large radio-frequency emission. Thus emission-line formation in radio galaxies could involve both synchrotron as well as collisional ionization. The bolometric correction depends on ν_c, has a minimum value of about 1 mag., and increases steeply for low ν_c; only a limited range of particle spectra and magnetic fields gives ν_c in the visible wavelengths. The effect of redshifts up to $\Delta\lambda/\lambda_c \approx 0.4$ is not large, except in sources with curved spectra. (auth)

42265 APPARENT LITHIUM ISOTOPE RATIOS IN F5-G8 DWARFS. G. H. Herbig (Lick Observatory, Mt. Hamilton, Calif.). Astrophys. J., 140: 702-6(Aug. 15, 1964).

The position of the center of gravity of Li I λ 6707, as measured at 4 Å/mm on 120-inch coudé spectrograms of fifteen F5–G8 dwarfs, was interpreted in terms of the shift in wavelength of the ^{7}Li doublet due to a minor contribution by ^{6}Li. The fine structures of the two isotopes are displaced from one another by 0.16 Å, or 7 km/sec, which is well above the probable error of locating the line center on these spectrograms 0.3–0.5 km/sec. The results are called apparent isotope ratios $R' = (^6\text{Li}/^7\text{Li})'$, on account of the approximate nature of the approach, although several possible sources of systematic error were investigated and found not to be of concern in these stars. The observed values of R′ range from 0 to about 0.5, and indicate that, although ^{7}Li is the preponderant isotope in the stars investigated (as it is in the Earth, Sun, and stone meteorites), some F- and G-type main-sequence stars apparently contain a significant amount of atmospheric ^{6}Li. (auth)

42266 THE ABUNDANCE OF IRON IN THE SOLAR PHOTOSPHERE. Leo Goldberg, Roger A. Kopp, and Andrea K. Dupree (Harvard and Smithsonian Observatories, Cambridge, Mass.). Astrophys. J., 140: 707-12 (Aug. 15, 1964).

New measurements of the absolute f-values of Fe I lines by Corliss and Warner made possible a new determination of the abundance of iron in the solar photosphere. Of the 628 lines used to obtain the curve of growth by the method of weighting functions, the majority fall on the linear branch of the curve and have lower excitation potentials in the range 3–5 ev. Since their mean optical depths of formation are as large as 0.6, it seems unlikely that the lines are significantly affected by departures from LTE. The resulting abundances appear to be independent of excitation potential, but seem to increase slightly with increasing wavelength. The average value of the derived abundance, $\log N_{Fe}/N_H + 12.00 = 6.64$, is in very good agreement with other modern determinations. (auth)

42267 THE POPULATIONS OF THE DISCRETE LEVELS OF ATOMIC HYDROGEN IN THE CHROMOSPHERE. A. E. Kingston (Joint Inst. for Laboratory Astrophysics, Boulder, Colo.). Astrophys. J., 140: 736-41(Aug. 15, 1964).

The effect of electron collision processes on the populations of the discrete levels of atomic hydrogen in the chromosphere is considered. The rate coefficients for collisional processes are much larger than those used in previous calculations. It is found that the difference in the populations of all the excited states from the thermodynamical equilibrium values is considerably changed from the results obtained in previous calculations. For states with principal quantum number, $j > 10$, the populations are close to what one would obtain if local thermodynamical equilibrium conditions were assumed. (auth)

42268 VELOCITY FIELD IN THE SOLAR CHROMOSPHERE NEAR QUIESCENT FILAMENTS. Josip Kleczek (Air Force Cambridge Research Labs., Sunspot, N. Mex.). Astrophys. J., 140: 742-5(Aug. 15, 1964).

The velocity field in the chromosphere near a quiescent prominence is suppressed. The suppression seems to increase with height in the chromosphere. The random turbulent velocities are about 0.3 km/sec smaller near the filament than in the normal quiescent chromosphere. (auth)

42269 ON THE ASSOCIATION BETWEEN LOOP PROMINENCES AND FLARES. A. Bruzek (Air Force Cambridge Research Labs., Sunspot, N. Mex.). Astrophys. J., 140: 746-59(Aug. 15, 1964).

The evolution of loop prominence systems (LPS) and their relation to flares were studied using Hα observations from the solar limb and the solar disk. The limb observations show that a small LPS may start to develop from a flare knot several minutes after flare onset. The LPS's then grow discontinuously at a rate of the order of 10 km/sec by the formation of higher and higher loops which attain maximum heights of 40,000 up to 150,000 km (average value, 83,000 km); they have a characteristic lifetime of 12 hours. All LPS's so far detected on the disk (25 cases) were closely related to major flares of the two-strand expanding type which produced strong SSWF effects (100 per cent), Type IV bursts (95 per cent), and PCA effects (85 per cent). Depending on their position the LPS's appeared on the disk in various shapes and with different delay times after flare onset; they were visible either in emission or in absorption. The observations strongly suggest that the LPS's are part of a powerful flare event and are due to a propagation of the flare process into the solar corona. A model of the evolution of the combined flare-loop system is derived from the observations. (auth)

42270 POLARIMETRIC OBSERVATIONS OF A CORONAL CONDENSATION. Kuniji Saito (Tokyo Astronomical Observatory) and Donald E. Billings. Astrophys. J., 140: 760-77(Aug. 15, 1964).

Direct photographs of the solar corona were taken at the total eclipse in New Guinea on February 5, 1962, with a quadruple-lens camera of focal length 2.28 m and with polaroid plates on four position-angles differing by 45° each. Isophotes in polarized and unpolarized light of a conspicuous coronal condensation on the west limb are obtained after subtracting the contribution of the general corona. This condensation consists mainly of three loops with a surrounding halo. Polarization data give a three-dimensional configuration for these objects: two of them, at least, were inclined 20–30° forward from the projected celestial plane, and were lying over an active region on the Sun's surface. By supposing an axial symmetry of distribution, the electron densities in the condensation are obtained as far as 1.5 R. The cross-sectional distribution is well fitted by combinations of Gaussian curves. Application of hydromagnetic theory enables magnetic lines of force to be drawn in the condensation for the assumed temperatures of 10^6, 1.5×10^6, and 2×10^6°K. By following the hydrodynamic processes along magnetic tubes of force, various curves showing temperature as a function of distance from the Sun are obtained. These are tested for plausibility by evaluating the heat input implied by each curve. Only one curve gives heat input as a plausible function of distance from the Sun. (auth)

42271 ACCRETION OF INTERSTELLAR MATTER BY MASSIVE OBJECTS. E. E. Salpeter (Cornell Univ., Ithaca, N. Y. and Goddard Inst. for Space Studies, New York). Astrophys. J., 140: 796-800(Aug. 15, 1964).

Observations of quasi-stellar radio sources have indicated the existence in the universe of extremely massive objects of relatively small size. The possible further growth in mass of a relatively massive object by means of accretion of interstellar gas onto it and the accompanying energy release is discussed. Although there is no evidence for quasi-stellar radio sources occurring inside ordinary galaxies, for the sake of concreteness, the fate of an object of mass $M > 10^6$ solar mass in an ordinary spiral galaxy is considered. (C.E.S.)

42272 COOLING OF INTERSTELLAR GAS. A. Dalgarno and M. R. H. Rudge (Queen's Univ. of Belfast). Astrophys. J., 140: 800-2(Aug. 15, 1964).

It is generally supposed that the cooling of interstellar H I clouds is through electron impact excitation of low-lying levels of C^+, Si^+, and Fe^+ for temperatures below about 60°K and through hydrogen-atom impact excitation of the rotational levels of H_2 for temperatures above ~60°K. A third cooling mechanism is proposed which is probably more efficient than electron impact at all temperatures and which is probably more efficient than rotational excitation of H_2 at temperatures below 100°K if $n(H_2) = 0.1\ n(H)$, below 300°K if $n(H_2) = 0.01\ n(H)$, and below 1000°K if $n(H_2) = 0.001\ n(H)$. The cooling mechanism is the excitation of low-lying levels of C^+ and Si^+ in spin-flip collisions with hydrogen atoms. (C.E.S.)

42273 IS THERE RADIATIVE EQUILIBRIUM IN SUNSPOTS? W. Mattig and E. H. Schroeter (Fraunhofer Institut, Freiburg i. B.). Astrophys. J., 140: 804-7 (Aug. 15, 1964).

The assumption of radiative equilibrium in sunspots is tested. In particular, the influence of Fraunhofer lines on the temperature distribution (blanketing effect) is taken into account to a first approximation. It is concluded that if the estimates of the blanketing effect in sunspots are of the right order of magnitude, then the deeper but still visible layers of sunspots show a marked deviation from radiative equilibrium. (C.E.S.)

42274 STABILITY OF MASSIVE STARS IN GENERAL RELATIVITY. Robert F. Tooper (Illinois Inst. of Tech., Chicago). Astrophys. J., 140: 811-14(Aug. 15, 1964).

In view of current interest in very massive stars (10^6–10^8 mass of sun) as models for the quasi-stellar radio sources, the internal structure and stability properties of massive stars based on the assumption of constant β (ratio of gas pressure to total pressure) are examined using the field equations of general relativity. Contrary to the situation in Newtonian theory, in general relativity there is a wide class of equilibrium solutions that are unstable with respect to radial pulsations. (C.E.S.)

42275 MAGNETIC FIELDS IN THE LOOP PROMINENCE OF MARCH 16, 1964. Charles L. Hyder (Univ. of California, Los Angeles). Astrophys. J., 140: 817-18 (Aug. 15, 1964).

The strength of the magnetic fields in a loop prominence is inferred from measurements of linear polarization in Hα condensations at the extrema of the loops. (C.E.S.)

42276 ON THE EXACT SOLUTION OF TRANSFER EQUATION IN THE MILNE-EDDINGTON MODEL: CONSERVATIVE, GREY ISOTROPIC SCATTERING. Santi Ranjan Das Gupta (City Coll., Calcutta). Indian J. Theoret. Phys., 6: 39-50(June 1958).

The conservative case of isotropic grey scattering of radiation in the outer layers of a star is considered. Chandrasekhar's H-function $H(\mu)$ (giving the law of limb darkening) is obtained in an alternative integral form which can be tackled much more easily than the integral form of the same deduced by Chandrasekhar. A definite advantage of the present integral form lies in the fact that from it one can deduce an analytically consistent closed form of $H(\mu)$ defined for the entire complex μ-plane, by a polynomial curve-fitting in the range (0,1). There arise certain problems wherein a closed form of $H(\mu)$ (defined for the entire μ-plane) proves to be of valuable utility in mathematical analysis as well as in minimizing labor of numerical computations. The present method of solution differs from the usual Wiener-Hopf technique only in the initial set-up which is so designed as to get the final integral with limits of integration between 0 and 1 instead of between $-\infty$ and ∞. If high accuracy is not wanted one can have a closed form of $H(\mu)$ involving a curve-fitting polynomial of degree 4. Values of $H(\mu)$ obtained from this closed form agree up to third place after the decimal point, with Chandrasekhar's determinations of the same from the numerical evaluation of his integral form of $H(\mu)$. (auth)

42277 ON THE EXACT SOLUTION OF TRANSFER EQUATION IN THE MILNE-EDDINGTON MODEL: SCATTERING ACCORDING TO RAYLEIGH PHASE FUNCTION. Santi Ranjan Das Gupta (City Coll., Calcutta). Indian J. Theoret. Phys., 6: 77-84(Sept. 1958).

The transfer equation for the conservative case of grey scattering according to Rayleigh phase function is exactly solved by Wiener-Hopf technique. The law of darkening H(z) is obtained in a closed form, as an explicit function of z. defined for the entire complex z-plane. The asymptotic form of the average intensity comes out as a linear function of the optical depth. (auth)

42278 ON THE ESTIMATE OF THE ASYMPTOTIC VALUE OF OPTICAL THICKNESS OF A SPHERICALLY SYMMETRIC STELLAR ATMOSPHERE IN THE NON-CONSERVATION CASE IN THE SECOND APPROXIMATION. K. K. Sen (Univ. of Malaya, Singapore, China). Indian J. Theoret. Phys., 7: 45-52(Sept.-Dec. 1959).

The asymptotic value of the optical thickness of a spherically symmetric stellar atmosphere was calculated in the second approximation for non-conservative isotropic scattering case. The Wick-Chandrasekhar method was used for solving the integro-differential equation of transfer appropriate to the problem. (auth)

42279 OBSERVATION IN THE ANTARCTIC OF SOLAR COSMIC RAY EVENTS IN 1962 AND 1963. A. D. Goedeke and A. J. Masley (Douglas Missile and Space Systems Div., Santa Monica, Calif.). J. Geophys. Res., 69: 4166-9(Oct. 1, 1964).

The 30 Mc riometer observations taken during 1962 and 1963 at McMurdo Sound, Antarctica, of events associated with solar cosmic rays are discussed. (C.E.S.)

42280 SURVIVAL OF THIN FILMS IN SPACE. James A. Van Allen (State Univ. of Iowa, Iowa City). J. Geophys. Res., 69: 4170-2(Oct. 1, 1964).

Radiation observations with earth satellites and with interplanetary probes using detectors whose sensitive volumes were exposed directly to outer space through thin films of metal or mica are summarized. None of these detectors failed as a result of puncture. The data are presented to establish a level of confidence for experimenters engaged in the design of space equipment involving thin films and to provide crude upper-limit data on the flux of micrometeoroids in space. (C.E.S.)

42281 THE S^{32}/S^{34} RATIO IN TROILITE FROM THE BRUDERHEIM AND PEACE RIVER METEORITES. H. R. Krouse and R. E. Folinsbee (Univ. of Alberta, Edmonton, Can.). J. Geophys. Res., 69: 4192-3(Oct. 1, 1964).

The $^{32}S/^{34}S$ ratios in troilite separated from the Bruderheim and Peace River meteorites were compared. The detected difference in the $^{32}S/^{34}S$ ratio of the two meteorites was less than 0.01%, which was judged to be the precision of the analyses. (C.E.S.)

42282 GAMMA RADIATION EMITTED BY THE PEACE RIVER CHONDRITE. H. W. Taylor (Univ. of Alberta, Edmonton, Can.). J. Geophys. Res., 69: 4194-6(Oct. 1, 1964).

A low-level counting facility was employed to investigate the gamma radiation emitted by the chondrite. On the basis of the observed photopeak energies the isotopes ^{26}Al, ^{40}K, ^{22}Na, and ^{54}Mn were identified. The ^{40}K and ^{26}Al abundances were measured, and the argon retention date of the chondrite was calculated as 0.96 billion years. (C.E.S.)

42283 PEACE RIVER METEORITE. H. Baadsgaard, R. E. Folinsbee, and G. L. Cumming (Univ. of Alberta, Edmonton, Can.). J. Geophys. Res., 69: 4197-4200(Oct. 1, 1964).

Results of a chemical analysis on the meteorite are presented. The composition, atomic abundances of elements, and potassium-argon retention times are given. (C.E.S.)

42284 NOTE ON THE STRUCTURE OF THE SOLAR CHROMOSPHERE WITH SOME REMARKS ON THE ATHAY-THOMAS SPICULE MODEL. Osamu Namba (Sterrewacht "Sonnenborgh," Utrecht). Koninkl. Ned. Akad. Wetenschap., Proc., Ser. B, 64: 713-25(1961).

Recent observations showing that the spicules emit practically all the visual line emission of the chromosphere (h $\gtrsim$ 1000 km) require a reinterpretation of the chromospheric spectrum. Any spicule model combined with the spicule statistics should be able to explain the flash spectrum line intensities thus far obtained, which refer to the homogeneous chromosphere. With this condition, the spicule model developed by Thomas is tested. It is found that the radiation of the K line in the upper chromosphere can not be explained by this model, the assumed electron temperature (~50000°K) being too high. A new spicule model is suggested, in which the temperature is low (~6000°K) and the density is high (hydrogen content of the order of 10^{13} atoms per cm^3) through the chromosphere. This model is consistent with the Coates model derived from radio observations. The excitation of helium in the spicule is ascribed to the ultraviolet radiation from the hot, tenuous interspicular medium and from the corona. The broad profiles of the strongest chromospheric lines are explained in terms of "turbulence" and high opacity of the spicule. (auth)

42285 EVIDENCE FOR ASYMMETRY OF JUPITER'S VAN ALLEN BELT. J. A. Roberts and M. M. Komesaroff (Commonwealth Scientific and Industrial Research Organization, Sydney). Nature, 203: 827-30(Aug. 22, 1964).

Variations in the intensity and polarization of the radiation from Jupiter were observed, demonstrating the beaming of the radiation and indicating asymmetry of the radiation belt. (D.C.W.)

42286 RELATIVISTIC EQUATIONS FOR ADIABATIC, SPHERICALLY SYMMETRIC GRAVITATIONAL COLLAPSE. Charles W. Misner (Univ. of Maryland, College Park) and David H. Sharp. Phys. Rev., 136: B571-? (Oct. 26, 1964).

The Einstein equations for a spherically symmetrical distribution of matter are studied. The matter is described by the stress-energy tensor of an ideal fluid (heat flow and radiation are therefore excluded). In this case, the Einstein equations give a generalization of the Oppenheimer-Volkoff equations of hydrostatic equilibrium so as to include an acceleration term and a contribution to the effective mass of a shell of matter arising from its kinetic energy. A second equation also appears in this time-dependent case; it gives the rate of change of an appropriate total energy m(r,t) of each fluid sphere in terms of the work done on this sphere by the fluid surrounding it. These equations would be an appropriate starting point for a study of relativistic gravitational collapse in which an adiabatic equation of state more realistic than the p = 0 form of Oppenheimer and Snyder could be used. (auth)

42287 GRAVITATIONAL COLLAPSE. Hong-yee Chiu (Goddard Inst. for Space Studies, Greenbelt, Md. and Columbia Univ., New York). Phys. Today, 17: 21-6; 28-30; 32-4(May 1964).

Observations on the features of quasi-stellar radio sources are reviewed, together with theoretical speculations based largely on the energy requirements of such sources. The theory of gravitational collapse is stressed. (D.C.W.)

42288 ON ELEMENT SYNTHESIS AND THE INTERPRETATION OF THE ABUNDANCES OF HEAVY NUCLIDES. Hans E. Suess (Univ. of California, San Diego, La Jolla). Proc. Natl. Acad. Sci. U. S., 52: 387-97(Aug. 1964).

Arguments are presented against the assumption that the solar element abundance distribution is a mixture of material from several different independent sources. It is then shown that no evidence can be derived from the nuclear abundance distribution in the solar system supporting synthesis of the heavy elements by the processes proposed by Burbidge, Burbidge, Fowler, and Hoyle. (D.C.W.)

42289 THE ORIGIN OF THE ELEMENTS. William A. Fowler (California Inst. of Tech., Pasadena). Proc. Natl. Acad. Sci. U. S., 52: 524-48(Aug. 1964).

The origin of the elements is discussed in the context of stellar nucleosynthesis, with consideration of the experimental evidence. (D.C.W.)

42290 THE HISTORY OF STARS AND GALAXIES. Jesse L. Greenstein (Carnegie Institution of Washington, Washington, D. C. and California Inst. of Tech., Pasadena). Proc. Natl. Acad. Sci. U. S., 52: 549-65(Aug. 1964).

The current theory of the evolution of galaxies and stars is outlined, with reference to experimental observations. Both normal processes and stellar catastrophes, notably superexplosions, are considered. (D.C.W.)

42291 THE HISTORY OF THE SOLAR SYSTEM. Fred L. Whipple (Smithsonian Astrophysical Observatory and Harvard Coll. Observatory, Cambridge, Mass.). Proc. Natl. Acad. Sci. U. S., 52: 565-94(Aug. 1964).

Theory for the development of the earth, giant planets and their satellites, comets, terrestrial planets, and the moon is reviewed, together with the bases for the theory. 56 references. (D.C.W.)

42292 INITIAL RESULTS FROM THE FIRST INTERPLANETARY MONITORING PLATFORM (IMP-I). Trans. Am. Geophys. Union, 45: 501-20(Sept. 1964).

The IMP-1 satellite and its orbit are briefly described; and experiments on the interplanetary magnetic field, cosmic radiation, and solar wind are reviewed, including instrumentation and results. (D.C.W.)

42293 SOLAR-GEOPHYSICAL ACTIVITY IN 1963. Trans. Am. Geophys. Union, 45: 531-4(Sept. 1964).

The major solar flares and geomagnetic disturbances during 1963 are summarized, together with actions by the World Warning Agency. Sunspot numbers for the current solar-activity cycle are plotted and discussed. (D.C.W.)

42294 ROCKET ASTRONOMY STUDIES OF THE CRAB NEBULA. X-RAY SOURCES IN SPACE AND THE NEUTRON-STAR CONCEPT. Trans. Am. Geophys. Union, 45: 561-5(Sept. 1964).

Rocket observations of x-ray emission from the Crab Nebula during lunar eclipse of the Nebula are reviewed, indicating the absence of a neutron star in the Nebula. Explanations proposed for the observed emission are indicated. Observations on the evolution and features of supernovas are summarized, together with some proposed theories. (D.C.W.)

Atomic Physics

Refer also to abstracts 41477, 42477, 42727, and 42729.

42295 (ANL-6879(p.114-29)) EXTRANUCLEAR PROPERTIES OF MATTER. (Argonne National Lab., Ill.).

Fragmentation of hydrocarbons, atomic and ionic impact phenomena on metal surfaces, kinetics of gas-phase reactions, molecular composition of high-temperature vapors, and normal-mode vibrations of the S_8 molecule were studied using mass spectrometry. Plasma in uniform electric fields were also investigated. (D.C.W.)

42296 (CONF-681-1) PROPAGATION OF ELECTROMAGNETIC WAVES IN SOLIDS (EXPERIMENTAL). R. Bowers (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Aug. 17, 1964. Contract AT (30-1)-2179. 46p.

From International Colloquium on Plasma Effects in Solids, Paris, July 1964.

A review is given of experiments on helicon waves and Alfvén waves in solids. Among the topics covered are: standing waves, transmission experiments, quantum oscillations, Doppler shifted cyclotron absorption, and interaction of helicons with sound waves. A bibliography of 35 references is included. (auth)

42297 (DESY-64/9) GRUNDLAGEN DES ÜBERALL-EFFEKTS. (Basis of the Uberall Effect). U. Timm (Deutsches Elektronen-Synchrotron, Hamburg). June 1964. 33p.

The coherent production of bremsstrahlung by electrons in a crystal target is usually called the Überall Effect. This phenomenon is characterized by two features: (1) There is an enhancement of the normal bremsstrahlung intensity in the form of a line shaped spectrum; these lines having steep slopes to higher quantum energies and decrease rapidly in intensity towards the peak energy. (2) In these lines the quanta are strongly polarized. The use of polarized gamma beams at DESY is discussed. (auth)

42298 (ORNL-P-193) MASS SPECTROMETRIC STUDIES OF SPUTTERED PARTICLES FROM COPPER MONOCRYSTALS. A. L. Southern (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 6p. (CONF-649-6)

From 12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964.

A high-vacuum mass spectrometer was used to study the type, intensity, and energy of particles sputtered from copper monocrystals by argon ions. (R.E.U.)

42299 (RM-4082-AEC) SOME APPLICATIONS OF THE TIETZ APPROXIMATION TO THE THOMAS-FERMI ATOM. S. A. Moszkowski (RAND Corp., Santa Monica, Calif.). Aug. 1964. Contract AT(04-3)-414. 48p.

Using a simple analytic approximation to the Thomas-Fermi potential due to Tietz, an explanation of the empirical $N+\ell$ rule for the filling of atomic levels was previously given, but appears to be little known. The main point of the report is two fold: (1) to review this derivation of the $N+\ell$ rule, and (2) to use the Tietz approximation in conjunction with the statistical method for deriving simple and analytical (though very approximate) expressions for electron densities in loosely bound atomic orbits. (auth)

42300 ULTRASOFT X-RAY ABSORPTION COEFFICIENTS OF Al, Be, C, O, AND F. W. T. Ogier, G. John Lucas, and Raymond J. Park (Pomona Coll., Claremont, Calif.). Appl. Phys. Letters, 5: 146-7(Oct. 1, 1964).

The results of a series of absorption measurements made directly on Al, Be, C, O, and F are reported. The x rays used were the K bands of Al, Mg, and C and the L band of Cu produced by proton bombardment. (C.E.S.)

42301 CALCULATION OF COLLISION CROSS SECTIONS FOR LOW-ENERGY ELECTRON SCATTERING BY NEUTRAL SODIUM ATOMS. Albert Salmona. Cahiers Phys., 17: 465-88(Dec. 1963). (In French)

The scattering of electrons by neutral sodium atoms initially in the ground state is studied. The theory of atomic collisions by the method of partial waves and variational techniques used in atomic physics is reviewed. The integro-differential collision equations are derived. The equations are solved first by means of different approximations and then in a more exact fashion for electrons having zero energy. The results appear to be confirmed by recent experimental data. The system of differential equations describing the collision at energies just above the excitation energy of the first excited state of Na is solved, neglecting the integral terms. The results obtained are compared to the Born approximation and are found to be too small for the elastic cross sections and too large for the inelastic cross sections. (tr-auth)

42302 ISOTOPE SHIFT OF THE NITROGEN ABSORPTION BANDS IN THE VACUUM ULTRAVIOLET REGION. M. Ogawa, Y. Tanaka, and A. S. Jursa (Air Force Cambridge Research Lab., Bedford, Mass.). Can. J. Phys., 42: 1716-29(Sept. 1964).

The vibrational isotope shift of the nitrogen absorption bands was studied in the 830–1000 Å region. A 3-meter normal-incidence vacuum spectrograph was used with the helium continuum as background. According to the analysis, the vibrational quantum numbers assigned to the lowest observed vibrational levels for the various electronic states of $^{14}N_2$ are as follows: $(j^1\Sigma_u^+)$, 100 824 cm^{-1}, v = 0; $(b^1\Pi_u)$, 101 455 cm^{-1}, v = 1; $(1^1\Pi_u)$, 104 146 cm^{-1}, v = 5; $(p'^1\Sigma_u^+)$, 104 366 cm^{-1}, v = 0; $(m^1\Pi_u)$, 105 350 cm^{-1}, v = 5 ~ 7; $(o^1\Pi_u)$, 105 703 cm^{-1}, v = 0; $(b'^1\Sigma_u^+)$, 106 649 cm^{-1}, v = 4; $(p^1\Pi_u)$, 108 373 cm^{-1}, v = 9 ~ 10; $(q^1\Sigma_u^+)$, 109 833 cm^{-1}, v = 11 ~ 12; $(r^1\Sigma_u^+)$, 110 944 cm^{-1}, v = 10; (s ?), 116 688 cm^{-1}, v > 20; and (t ?), 118 486 cm^{-1}, v ≅ 23. The observed isotope shift for the bands $(r'^1\Sigma_u^+)$, 106 381 cm^{-1}; $(k^1\Sigma_u^+)$, 108 549 cm^{-1}; (f ?), 110 196 cm^{-1}; $(s'^1\Sigma_u^+)$, 110 664 cm^{-1}; $(h^1\Sigma_u^+)$, 112 777 cm^{-1}; (h′ ?), 114 841 cm^{-1}; (h″ ?), 116 820 cm^{-1}; and (h‴ ?), 118 778 cm^{-1} increases in this order and shows that none of these bands corresponds to a (0,0) band. (auth)

42303 DERIVATION OF THE WAVE FUNCTIONS FOR J = 1 + ½, J = 1 – ½ STATES AND FOR '0' SPIN USING KAR'S LINEAR HAMILTONIAN. Sabita Purkayastha (Inst. of Theoretical Phys., Calcutta). Indian J. Theoret. Phys., 6: 97-106(Dec. 1958).

The exact wave functions representing the two components of the energy levels due to spin, were obtained in a straightforward way, directly from the second order R-equation. The wave equation of a particle with zero spin was also deduced starting from Kar's linear hamiltonian. (auth)

42304 AN EVALUATION OF THE ARCHARD ELECTRON DIFFUSION MODEL. D. B. Brown and R. E. Ogilvie (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 35: 2793-5(Oct. 1964).

The predictions of the Archard diffusion model for electron trajectory within a specimen are compared with experimental data. The predicted distributions in depth of primary x-ray emissions are calculated. The applicability of the model to the absorption corrections in electron microanalysis is discussed in light of these calculations. (auth)

42305 DISSOCIATION OF VIBRATIONALLY EXCITED H_2^+ IONS BY AN ELECTRIC FIELD. A. W. Ehler (Hughes Research Labs., Malibu, Calif.). J. Appl. Phys., 35: 2858-61(Oct. 1964).

Ions produced by a Philips ionization gage (PIG) type discharge in hydrogen were injected into a cylindrical electric field which was varied in magnitude to give a maximum strength ranging from 65 to 450 kv/cm. H_2^+ ions in highly excited vibrational states were dissociated by the electric field. The measured fraction of the H_2^+ ions produced by the PIG discharge which were dissociated was 0.0011 ± 0.0002 at a field of 200 kv/cm. Numerous experimental checks demonstrated that the dissociation fraction could not be attributed to effects other than electric field dissociation. The fraction is several times greater than that measured elsewhere. This difference is attributed to the method used in the preparation of the H_2^+ ions. (auth)

42306 SOLUTIONS OF THE THOMAS-FERMI-DIRAC STATISTICAL MODEL OF ATOMS. Richard Latter (RAND Corp., Santa Monica, Calif.). J. Chem. Phys., 41: 2275-9 (Oct. 15, 1964).

Numerical integration of the zero-temperature Thomas-Fermi-Dirac equation was carried out on the IBM 701 for atomic numbers Z = 1 to 100. Compressed, expanded, and isolated atoms were treated, the latter using the boundary condition suggested by Jensen. Physical properties of interest for compressed and expanded atoms are presented graphically and, in the case of isolated atoms, tabularly as well. (auth)

42307 THEORY OF MAGNETIC MULTIPLE RESONANCE SPECTRA. Mitsuko Shimizu and Hiroshi Shimizu (Chiba Univ., Japan). J. Chem. Phys., 41: 2329-46 (Oct. 15, 1964).

A general theory of magnetic multiple resonance spectra is presented. It is shown that the spectra are conveniently calculated by transforming to an interaction frame. The pattern of the spectrum observed in this frame is equivalent to that observed in the laboratory frame. The theory is applied to the calculation of the resonance spectrum of a three-spin AMX system. It is theoretically shown that the multiple resonance technique is extremely powerful for the analyses of complex NMR spectra as well as for accurate determination of the magnitudes of chemical shifts and spin-spin coupling constants, even if the signals of the corresponding nuclei are hidden by other features of the spectrum. The relative signs of hidden spin-spin coupling constants can be determined from the intermediate patterns of multiple resonance spectra. (auth)

42308 COMPUTER SIMULATION OF A MOLECULAR STOPPING-POWER PROBLEM. S. S. Blackman and C. W. Hirt (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 41: 2443-52(Oct. 15, 1964). (LADC-6244)

A high-speed computer was used to calculate the trajectory of a fast test particle injected into a two-dimensional system of interacting point particles. All particles interact along lines of centers according to a repulsive inverse-power force law. The evolution of the test-particle velocity and energy averaged over many machine calculated trajectories was compared with a statistical theory based on binary collisions. In the case of an inverse-cube force law explicit theoretical results were obtained and showed excellent agreement with the machine calculations. A combined relaxation-time-Fokker-Planck kinetic equation for the test-particle distribution function is discussed; this equation includes the effects of both strong and weak collisions.

For the inverse-cube force law this equation is approximately solved for the energy distribution function and exhibits the principal features of the machine calculated energy distribution. (auth)

42309 CORIOLIS SHIFTS IN ELASTIC SCATTERING POTENTIALS. Walter R. Thorson and Andrew D. Bandrauk (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 41: 2503-7(Oct. 15, 1964).

Nonadiabatic effects (Coriolis shifts) were studied in the $^2\Sigma_\mu^+$ and $^2\Sigma_g^+$ states of H_2^+, for elastic scattering at high relative kinetic energies. The study was made to explore the effects in a simplest prototype system; conclusions are also qualitatively applicable to the He_2 system, for which earlier and incomplete studies were made. The phenomenon is relevant to the existing large discrepancy between adiabatic theoretical calculations and the results of high-energy scattering experiments determining the interaction potential in He_2. The results of the study are useful in a study of the scattering proper in the H_2^+ system. (auth)

42310 VELOCITY DISPERSION OF SQUARE-MODULATED MAXWELLIAN MOLECULAR BEAMS: THE INTEGRAL $F_n(x) = \int_0^\infty z^n \text{ EXP } (-z^2)\, dz$. Halstead Harrison (Boeing Scientific Research Labs., Seattle), David G. Hummer, and Wade L. Fite. J. Chem. Phys., 41: 2567-8(Oct. 15, 1964).

The integrals necessary for correcting signals from square-modulated Maxwellian beams detected by density-, flux-, momentum-, and energy-sensitive detectors were computed. The results are presented in graphical form. (P.C.H.)

42311 ON A SOLVABLE MODEL OF THE HYDROGEN MOLECULE. E. Corinaldesi (Univ. of Toronto). Nuovo Cimento (10), 33: 1680-97(Sept. 16, 1964).

Fictitious particles are defined in a way that simulates those properties of interacting electrons and protons which are essential for the formation of stable molecules. The Schrödinger equation for the analog of the hydrogen molecule can be solved exactly. The Heitler-London and the M.S.E. approximation are discussed. (auth)

42312 RADIATIVE CORRECTIONS TO HYPERFINE STRUCTURE IN HYDROGEN. D. E. Zwanziger (Centre d'Etudes Nucléaires, Saclay, France). Nuovo Cimento (10), 34: 77-80(Oct. 1, 1964).

Because of a reported discrepancy of (34 ± 21) parts per million between measured and calculated values of the hyperfine separation of the ground state of atomic hydrogen, the next higher-order radiative corrections beyond the order of $\alpha^2 s_{h.f.}$ were investigated. Besides the presence of corrections of order $\alpha^3 \ln\alpha_{h.f.}$, a larger correction of order $\alpha^3 \ln^2 s_{h.f.}$ was found. The calculation of the level shift of both of these logarithmic orders has been completed. In the case of hydrogen the numerical contribution is −9.28 ppm. When this is combined with previous results, the discrepancy between measured and calculated values is increased to (43 ± 21) ppm. The uncertainty is due largely to the uncertainty in the value of α, which is obtained from fine-structure measurements and which appears in the theoretical formula for the hyperfine separation. Possible explanations of the discrepancy are either an inaccuracy in the accepted value of the fine-structure constant or an inadequate evaluation of the contribution from intermediate states in which mesons are excited. (auth)

42313 AN IMPROVED INTERMOLECULAR POTENTIAL FUNCTION. S. Carrà (Università, Milan) and D. D. Konowalow. Nuovo Cimento (10), 34: 205-14(Oct. 1, 1964).

An intermolecular potential function of the form $\varphi(r) = \epsilon((n + b)/b)(r_m/r)^n[n/(n + b) \exp[b(1 - r/r_m)] - 1]$ is presented. With n = 6, this form is simpler and more realistic within the zero of the potential than the (exp − 6) potential. The classical second virial coefficient has been calculated for b = 6.0 to 9.0 in steps of 0.5 and $0.4 \leq kT/\epsilon \leq 400$. The potential parameters are determined for some rare gases from the experimental second virial coefficient and the separation between nearest neighbors in the crystal lattice at 0°K. (auth)

42314 AN INVESTIGATION INTO THE NUMBER OF NEIGHBOURING ATOMS TO BE INCLUDED IN CALCULATIONS OF THE SLOW NEUTRON SCATTERING CROSS SECTION OF DEFECTS IN SOLIDS. D. G. Martin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Chem. Solids, 25: 1005-13(Sept. 1964). (AERE-R-4527)

The calculated slow neutron scattering cross section of defects in solids possesses a term due to the core of the defect and another due to the relaxation of neighboring atoms. An attempt was made to investigate the number of relaxed atoms that must be included in the calculations in order that the final result may be independent of the number of atoms considered. The differential and also the total cross sections of an interstitial in a cubic primitive lattice have been calculated for various numbers of neighboring atoms, assuming an elastic continuum approximation to describe these relaxations. A number of values of the relaxations were used in these calculations, some of which are believed to correspond to relaxations around interstitials and vacancies in metals, and therefore to be directly applicable in these cases. It was found that in all cases the general shape of the curve obtained for a very large number of atoms appears when about 30 atoms are considered. However, more atoms are required to obtain the more detailed shape; for the transmission cross sections about 60 atoms are needed, while for the differential cross sections as many as 300, depending on the amount of the relaxation, may be necessary. (auth)

42315 A DIRECT MEASUREMENT OF THE LARGE ZERO FIELD SPLITTING OF Co^{2+} IN Cs_3CoCl_5. H. G. Beljers, P. F. Bongers, R. P. Van Stapele, and H. Zijlstra (Philips' Gloeilampenfabrieken, N. V., Eindhoven, Netherlands). Phys. Letters, 12: 81-2(Sept. 15, 1964).

A direct measurement is presented of the large zero-field splitting of the ground state of Co^{2+} ions in the compounds Cs_3CoX_5 (X = Br or Cl). In fields up to 8500 Oe transitions between the two Kramers doublets are observed. For the chlorocobaltate, the measurements yield a splitting (D) of $-4.31\ cm^{-1}$ and g-values of $g_{||} = 2.41$ and $g_\perp = 2.33$. For the bromocobaltate, $D = -5.4\ cm^{-1}$, $g_{||} = 2.6$, and $g_\perp = 2.4$. (T.F.H.)

42316 MOTION OF SWIFT CHARGED PARTICLES, AS INFLUENCED BY STRINGS OF ATOMS IN CRYSTALS. J. Lindhard (Universitet, Aarhus, Denmark). Phys. Letters, 12: 126-8(Sept. 15, 1964).

An outline is given of the effects of crystal structure on the trajectories of energetic particles through the crystals. The types of interactions studied are the following: screened Coulomb interactions with atoms as a whole; interactions with individual electrons and nuclei; and, in cases in which the particle moves nearly along a major direction in a lattice, interactions with strings of lattice atoms. (T.F.H.)

42317 CROSS SECTIONS FOR ION AND ELECTRON PRODUCTION IN GASES BY FAST HELIUM IONS (0.133-

1.0 Mev). I. EXPERIMENTAL. R. A. Langley, D. W. Martin, D. S. Harmer, J. W. Hooper, and E. W. McDaniel (Georgia Inst. of Tech., Atlanta). Phys. Rev., 136: A379-85(Oct. 19, 1964).

The measurement of apparent cross sections for production of slow positive ions and free electrons by He^+ ions incident on He, Ne, Ar, H_2, N_2, O_2, and CO in the energy range 0.133 to 1.0 Mev, and similar cross sections for He^{2+} ions incident on He and H_2 in the energy range 0.5 to 1.0 Mev is reported. Direct comparisons are made with experimental results obtained by others for He^+ ions at energies up to 0.40 Mev. (auth)

42318 CROSS SECTIONS FOR ION AND ELECTRON PRODUCTION IN GASES BY FAST HELIUM IONS (0.133-1.0 Mev). II. COMPARISON WITH THEORY. D. W. Martin, R. A. Langley, D. S. Harmer, J. W. Hooper, and E. W. McDaniel (Georgia Inst. of Tech., Atlanta). Phys. Rev., 136: A385-92(Oct. 19, 1964).

The theory of ionization of gases by fast, but nonrelativistic, ions is briefly reviewed, with emphasis on the correspondences expected at high energies among the cross sections for various projectile ions incident on a given target gas. The problem of deducing cross sections for simple ionization from experimental gross ion and electron production cross sections is discussed. The methods developed are applied to the experimental data. Estimates are thus obtained of the simple ionization cross sections for He^+ ions incident on H_2, He, Ar, and N_2 in the energy range 0.133 to 1.0 Mev, and He^+ on Ne, O_2, and CO in the energy range 0.6 to 1.0 Mev. Similar results are obtained for He^{2+} ions incident on H_2 and He in the energy range 0.5 to 1.0 Mev. These results are compared with semitheoretical predictions based upon empirical values of target-gas matrix elements determined from previous measurements of the ionization cross sections for protons incident on the same targets. It is shown that the ionization cross sections for He^{2+} conform rather well to the predictions, and that the ionization cross sections for He^+ ions are in good agreement with those expected for a point-charge ion with the helium mass and an effective charge of $Z'e = +1.2e$. The ionization cross sections are also compared with explicit detailed calculations in the full Born approximation for the cases where such calculations are available. The agreement obtained is quite good in general. (auth)

42319 VERIFICATION OF MOLIÈRE'S THEORY OF MULTIPLE SCATTERING FOR HEAVY IONS. William G. Simon (Univ. of California, Berkeley). Phys. Rev., 136: B410-15(Oct. 26, 1964).

The multiple-scattering distributions of 164-Mev ^{16}O ions from Au, Ni, and Al foils and of 400-Mev ^{40}Ar ions from Al and Zapon foils were measured. These measurements are of interest because they involve large values (2.9 to 30.8) of the Born parameter $\alpha = Z_1Z/137\beta$. The 1/e widths found in this experiment are in complete agreement with those calculated from Molière's theory and verify its accuracy to within 2% for large values of α. However, the accuracy is not sufficient to verify the detailed shape of the calculated distributions. The results of earlier experiments involving values of $\alpha > 1$ were also compared with Molière's theory. These results, with a few exceptions, agree to within 5 or 10% with calculations based on the theory, and are scattered about the theoretical values in such a way that no systematic differences can be inferred. Molière's theory agrees well with experiment for large values of α because it relies on a classical calculation of scattering to account for deviations from the Born approximation. The theory of Nigam, Sundaresan, and Wu, which uses a second Born approximation, overestimates the widths of the distributions by as much as 60%. (auth)

42320 SCATTERING OF SLOW NEUTRONS IN WEAKLY FERROMAGNETIC ANTIFERROMAGNETIC MATERIALS. V. G. Bar'yakhtar and O. I. Sinepol'skii. Soviet Phys.-Solid State (English Transl.), 6: 339-42(Aug. 1964). Translated from Fiz. Tverd. Tela, 6: 424-9(Feb. 1964).

The cross sections and the polarization of elastic and inelastic scattering of slow polarized neutrons in weakly ferromagnetic antiferromagnetic materials (Mn, Ni, and Co carbonates) were calculated. It is shown that in such ferromagnetic materials slow-neutron scattering consists not only of magnetic scattering by planes whose indices form an odd sum but also by planes having an even sum of indices, the intensity of this scattering being proportional to the square of the average magnetic moment in the body. Scattering of unpolarized neutrons in a scattered beam leads to polarization as the result of the interference between magnetic and nuclear scattering. The degree of polarization is proportional to the antiferromagnetic vector for reflections from planes having an odd sum of indices and to the ferromagnetic moment for reflections with an even sum of indices. (auth)

42321 ATOMNYE STOLKNOVENIYA (TEORIYA ELEKTRONNO-ATOMNYKH STOLKNOVENII). (Atomic Collisions (The Theory of Electron-Atomic Collisions)). V. Ya. Velbre, ed. Tr. Inst. Fiz., Akad. Nauk Latv. SSR, 13: 1-141(1963).

Seventeen articles are presented on the theory of electron-atom collisions. The first articles include the theories on the strong bond in electron-hydrogen collisions, collisions of slow electrons with hydrogen, and asymptotics describing partial waves. Positron collisions with hydrogen, reasonance phenomena in electron scattering on hydrogen, and the role of polarization effects in inelastic electron-atom collisions are discussed in the following three articles. Radial equations, Coulomb-Born approximation for s-s transitions, and applications of Bete approximation for calculation electron-ion excitation cross sections are analyzed as well as the behavior of cross sections near the new reaction threshold in the case of Coulomb attraction field, the resonance in electron scattering on ions, and the conservation of particle fluxes in collisions. The last three articles are concerned with calculations of the two-dimensional approximation for hydrogen atom ionization cross sections, hydrogen atom ionization by slow electrons, ionization of helium atom near the threshold, and ionization of excited helium atom. (R.V.J.)

42322 INTERACTIONS OF PLASMA BUNCHES WITH TRANSVERSE MAGNETIC FIELD. I. I. Demidenko, V. G. Padalka, B. G. Safronov, and D. K. Sinel'nikov. Zh. Tekhn. Fiz., 34: 1183-90(July 1964). (In Russian)

Interactions between plasma bunches, produced by a conical source, and a transverse magnetic field are studied. The configuration of plasma moving in a transverse field and confined by the magnetic field was analyzed. It is shown that the plasma confined by the magnetic field adheres strictly to the magnetic field lines. The magnetic field intensity variations induced by the moving bunches are determined and the rate of plasma propagation across and along the magnetic field was measured as well as the mass spectral composition of the plasma. (tr-auth)

42323 APPLICATIONS OF QUANTUM SCATTERING THEORY TO LOW ENERGY ELECTRON DIFFRACTION AND MOLECULAR COLLISIONS. John Washburn Brackett. Thesis, Lafayette, Ind., Purdue Univ., 1963. 318p.

The application of quantum scattering theory to the calculation of low-energy electron-atom scattering and molecular scattering was investigated. The validity of the WKB and Born approximations for calculating scattering phase shifts for electron-atom collisions was examined as a function of electron energy. The exact values of the phase shifts were obtained by numerical integration of the Schrödinger equation using the Runge-Kutta technique. For electron energies above 30–50 ev the WKB approximation reproduces the exact phases to within ±0.03 radians or less for phases with $l \leq 1$, where l is the angular momentum quantum number. The Born approximation in all cases examined was less accurate than the WKB approximation. Diffusion and viscosity cross sections were calculated using the Lennard-Jones potential for decreasing values of the quantum parameter $\lambda = h/\sigma\sqrt{m\epsilon}$. The cross sections vary rapidly with the value of the reduced kinetic energy, $K = \mu v^2/2\epsilon$, where ϵ is the maximum depth of the intermolecular potential. Correlations between the form of the intermolecular potential as a function of distance and the form of the phase shifts as a function of l permitted estimates of the sensitivity of viscosity, diffusion, and molecular beam scattering experiments to the attractive and repulsive portions of the potential. Two methods proposed by Bernstein for determining the Lennard-Jones potential parameters from measurements of total scattering cross sections as a function of velocity were tested; the parameters obtained were too high by approximately ten per cent. An iterative technique was developed for the calculation of phase shifts from molecular beam differential cross sections. The time required for analyzing one set of cross sections is less than 95 seconds on the IBM 7090. (A.G.W.)

42324 THE NATURAL STATES OF THE BERYLLIUM ATOM. Sidney James Fogel. Thesis, Gainesville, Fla., Univ. of Florida, 1963. 117p.

The problem of eliminating the wave function from quantum mechanics and replacing it with density matrices is explored by calculating the first and second order density matrices from Watson's thirty-seven configuration wave function. Löwdin's method of calculating the matrices is used, and a program to calculate the second order density matrices for systems with up to twenty fermions is described. A method for obtaining the ^1S projection of configurations s^2l^2 and $s^2l_1l_2$, where l_1 and l_2 have the same l value, is given. The direct ^1S projection of these configurations is shown to be unnecessary. The first and second order density matrices are diagonalized giving the natural 1- and 2-states with their respective occupation numbers. The electron distribution is given by natural 1-state occupation number, and the expansion of the wave function in products of geminals is calculated from the natural 2-states. It is shown that the geminals can be resolved into singlet and triplet states. The excited geminals are discussed, and it is shown that the natural geminals are dominated by the ground state and singly excited original basis geminals. Natural geminals essentially doubly excited have occupation numbers less than 6×10^{-5}. Correlation effects are discussed in terms of the natural geminals, where it is shown that the first three geminals of largest occupation number are singlets, but with angular correlation appearing. The 2s–2p orbital degeneracy referred to by Watson is verified. (Dissertation Abstr., 25: No. 1, 1964)

42325 SEMICLASSICAL CALCULATION OF THE DIFFERENTIAL SCATTERING CROSS SECTION WITH CHARGE EXCHANGE: CESIUM IONS IN CESIUM VAPOR. John William Sheldon. Thesis, College Station, Tex., Agricultural and Mechanical Univ., 1964. 79p.

The differential scattering cross section of an ion in its parent gas is calculated for an inverse fourth attractive (polarization) potential. The effect of charge exchange is included. The ion and atom paths during collision are computed classically, but the results of quantum mechanical charge exchange probability calculations are used. Expressions are given for the range of energy and scattering angle over which this semiclassical approach is valid. The differential cross section is shown to have a peak near an apparent scattering angle of 180°. Approximate expressions are given for the value of the cross section at the peak and the scattering angle at which it occurs. Values of the differential cross section for cesium ions in cesium vapor are obtained using the results of total charge exchange cross section and atomic polarizability measurements. These calculations are expected to be valid for cesium ion-atom collision energies between 0.025 and 1000 ev. The relationship between total cross section, charge exchange cross section, and diffusion cross section is discussed. The determination of the total cross section from a scattering chamber type experiment is presented and compared with experiments. (Dissertation Abstr., 25: No. 1, 1964)

42326 SCHOTTKY DEVIATIONS FOR SINGLE-CRYSTAL MOLYBDENUM. Thomas Herman Zepf. Thesis, St. Louis, St. Louis Univ., 1963. 193p.

The theoretically predicted photoelectric Schottky deviations were observed for emission from a molybdenum single crystal grown in 0.004-in. diameter polished wire using a modified Robinson heating schedule. Photo-currents were measured from a 30°-sector of the crystal centered around the (1 1 1) direction. Experimental runs were made with the research tube pressure in the 10^{-10} torr region. Background currents were controlled so that the deviations could be measured from theoretical Fowler-Schottky first-order curves normalized to the experimental data. The data exhibit agreement with theory in the deviation period and in the increase of amplitude with applied electrostatic field. The deviation phase agrees best with that calculated by Juenker (Phys. Rev., 99: 1155(1955)) for a square-well image-force potential barrier while the amplitude is approximately two times that calculated by Juenker. A reproducible change in phase, amplitude, and period, possibly due to adsorption of residual gases by the photoemission surface, was observed. As a check on the photoelectric results, thermionic measurements were obtained from the same single-crystal surface and in the same research tube as the photoelectric data. The observed thermionic Schottky deviations were found to agree with the photoelectric results in phase, period, and increase in amplitude with applied electrostatic field. (Dissertation Abstr., 25: No. 1, 1964)

42327 KERNENERGIE, GESTERN, HEUTE UND MORGEN. (Nuclear Energy, Past, Present, and Future). Hans Thirring and Hans Gruemm. Vienna/Munich, R. Oldenbourg, 1963. 252p.

The past, present, and future development of nuclear energy is reviewed for the technically oriented layman. The physical principles of nuclear energy are presented, and the concepts leading to the development of the atomic bomb are discussed. The transition to peaceful development is described. (J.S.R.)

42328 ON THE NON-RELATIVISTIC HIGH ENERGY PHOTOIONIZATION CROSS SECTION. Robert R. Johnston (Lockheed Missiles and Space Co., Palo Alto, Calif.). 11p. (CONF-452-50)

From American Physical Society, Washington, D. C., Apr. 1964.

It is shown that the use of the dipole acceleration form of the photoionization cross section in a high energy Born expansion gains one iterate of the Born series over the corresponding expansion of the dipole velocity cross section. Some comparisons with Hartree-Fock indicate the domain of validity of the acceleration Born approximation. (auth)

Cosmic Radiation

Refer also to abstract 42540.

42329 (IAE-618) PARNAYA UGLOVAYA KORRELYATSIYA VTORICHNYKH CHASTITS V KOSMICHESKIKH LIVNYAKH S ENERGIEI $E_0 > 10^{11}$ ev. (Pair Angular Correlation of Secondary Particles in Cosmic Showers With Energies $E_0 > 10^{11}$ ev). A. P. Mishakova and B. A. Nikol'skii (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 16p.

The distribution of paired angles for cosmic shower secondary particles at $E_0 > 10^{11}$ ev was compared with distributions calculated with the assumption of a lack of systematic angular correlations. The results are analyzed from the point of view of unstable shower particles decaying into short life charged particles. (tr-auth)

42330 (UCRL-12008-T) SOME COSMIC RAY GAMMA-RAY MEASUREMENTS OVER SOUTH AMERICA DURING 1964. Raymond G. D'Arcy and John R. McCall (California. Univ., Livermore. Lawrence Radiation Lab.). July 30, 1964. Contract W-7405-eng-48. 5p. (CONF-687-1)

From Meeting of the Latin-American Council for Cosmic Radiation and Space Physics, Tucuman and Buenos Aires, Aug. 1964.

Preliminary qualitative results are presented of cosmic gamma spectral data taken during the periods January 16 to February 18 and July 7 to 23, 1964 from 50°N to 72°S latitude and 40 to 80°W longitude from Boston to the Antarctic. (R.E.U.)

42331 (FTD-TT-64-892(p.202-16)) INVESTIGATION OF RADIATION WITH THE FLIGHTS OF THE "MARS-1" AND "LUNA-4" INTERPLANETARY AUTOMATIC STATIONS. S. N. Vernov, A. E. (Ye.) Chudakov, P. V. Vakulov, E. (Ye.) V. Gorchakov, Yu. I. Logachev, G. P. Lyubimov, A. G. Nikolaev (Nikolayev). Translated from Kosmich. Issled., 2: 633-40(July-Aug. 1964).

The cosmic radiation recording instruments and results for the Mars-1 and Luna-4 flights are discussed. (R.E.U.)

42332 A MEASUREMENT OF THE PRIMARY PROTON FLUX FROM 10 TO 130 MILLION ELECTRON VOLTS. Edward C. Stone (Univ. of Chicago). J. Geophys. Res., 69: 3939-45(Oct. 1, 1964).

A counter telescope, composed of nine AuSi solid-state detectors for measuring the energy loss and range of vertically incident particles, was carried into a polar orbit by an oriented satellite on December 12, 1961. The choice of detectors and absorbers allowed separation of protons and α particles with energies between 10 and 250 Mev/nucleon. Although the quantity of data was limited by the failure of the vehicle transmitter, both the observed 85- to 130-Mev proton flux and the α-particle flux are consistent with other 1961 observations. In addition, a proton flux of $\sim 1\ m^{-2}\ sec^{-1}\ ster^{-1}\ Mev^{-1}$ was measured in the energy range 10-85 Mev, indicating that the quiet time spectrum was much flatter than the E^{-2} spectrum that others have observed at higher energies. (auth)

42333 COSMIC RAY BALLOON MEASUREMENTS AT LOW GEOMAGNETIC LATITUDES, SEPTEMBER 1962 THROUGH MARCH 1964. H. S. Ghielmetti (Comision Nacional de Energia Atomica, Buenos Aires), N. Becerra, A. M. Godel, H. Heredia, L. C. Murzulli, and J. G. Roederer. J. Geophys. Res., 69: 3959-63(Oct. 1, 1964).

In a series of high-altitude cosmic ray intensity measurements, the technique of constant level flights with small extensible balloons was used. A reliable valve-controlled system to level neoprene balloons with payloads of several kilograms at atmospheric depths between 4 and 10 g/cm^3 was developed. The detector system consisted of a double coincidence GM counter telescope unit with telemetry of single counting rates, coincidence rate, atmospheric pressure, and internal temperature. Total payload weight was only 1500 grams. Thirty-seven balloon flights were made during the last two years to study the cosmic ray intensity at high altitudes and low altitudes. A computing method was developed to fit a function of the type $C\ (x,p_\lambda) = A\ \exp\ (-x/L) - B\ \exp\ (-x/l)$ to the counting rate versus atmospheric depth curve for each flight. This fit turned out to be excellent, leading to comprehensive information on the cosmic ray absorption, condensed into only three cutoff dependent parameters A, B, and L, and a constant parameter l. L represents the absorption length of the ionizing component; its mean value at 11.4-gv geomagnetic cutoff rigidity was found to be 158 g/cm^2. The parameter l, representing the apparent mean collision length, has a value of 86 g/cm^2. This method provides a statistically accurate way to determine the extrapolated counting rate at the top of the atmosphere, given by the difference $C_0 = A - B$. The correlation of the calculated counting rates at Pfotzer maximum and at the top of the atmosphere with the Mina Aguilar neutron monitor rate is analyzed for a period of 18 months of decreasing solar activity. A gradual softening of the primary spectrum during the eleven-year cycle recovery is revealed. (auth)

42334 AN UNEXPECTED EFFECT IN SOLAR COSMIC RAY DATA RELATED TO 29.5 DAYS. Helen W. Dodson and E. Ruth Hedeman (Univ. ov Michigan, Pontiac). J. Geophys. Res., 69: 3965-71(Oct. 1, 1964).

Data relating to the detection of solar protons in the neighborhood of the earth (1952-1963) and to neutron counts (1958-1963) were distributed on the basis of the mean synodic solar rotation period, 27.3 days, and the approximate synodic month, 29.5 days. In the latter, apparent departures from random distribution are especially marked. At the present time it is not clear whether the 29.5-day effect is related to the sun or the moon or is only a statistical accident. (auth)

42335 THE COSMIC-RAY EQUATOR AT 170° WEST LONGITUDE. M. A. Shea (Emmanuel Coll., Boston). D. F. Smart, and J. F. Kenney. J. Geophys. Res., 69: 4162-5 (Oct. 1, 1964).

In an effort to obtain a more accurate determination of the cosmic-ray equator for 170° west longitude, the vertical cutoff rigidity for each degree of latitude within this range was determined by means of a digital computer. The computer program for these calculations utilizes a sixth-degree simulation of the geomagnetic field. From the analysis it is concluded that the cosmic-ray equator at 170°W is

1.00 ± 0.5°S. It was also shown that, although the L parameter may be useful for many cosmic-ray analyses, it cannot be used as a substitute for cutoff rigidities in equatorial regions when accurate determinations are necessary. (C.E.S.)

42336 MEASURES SECURING RADIATION SAFETY IN VOSTOK-3 AND VOSTOK-4 SATELLITE FLIGHTS. V. V. Antipov, Yu. I. Efremov, M. D. Nikitin, I. A. Savenko, and P. P. Saksonov. Kosmich. Issled., 1: 303-8(Sept.-Oct. 1963). (In Russian)

Data are presented on the radiation conditions in space during Vostok-3 and -4 flights. Descriptions are given of the radiation protection measures taken for the flights. (R.V.J.)

42337 DISCOVERY OF 40-ev TO 5-kev ELECTRONS IN THE UPPER ATMOSPHERE. T. M. Mulyarchik. Kosmich. Issled., 2: 266-71(Mar.-Apr. 1964). (In Russian)

Counters with fluorescent screens placed in Cosmos-5 recorded electrons with energies from 0.04 to 4 kev. The maximum intensity reached 5×10^9 e/cm^2 sec^{-1}; the mean intensity was 5×10^8 e/cm^2 sec^{-1}. There is a tendency toward higher intensities at increased elevations. The electrons were recorded only in the lighted region of the atmosphere; they disappeared when the satellite entered the shadow side. (R.V.J.)

42338 INVESTIGATION OF COSMIC EMISSIONS AT 200 TO 350 km USING THE COSMOS-4 AND COSMOS-7 SATELLITES. R. N. Basilova, S. N. Vernov, V. E. Nesterov, N. F. Pisarenko, I. A. Savenko, and P. I. Shavrin. Kosmich. Issled., 2: 280-8(Mar.-Apr. 1964). (In Russian)

Thirteen equatorial cosmic-ray points were indicated by the Geiger counters placed in Cosmos-4 and Cosmos-7. The count-rate distribution indicated a relation between the recorded emissions and the initial cosmic rays. The longitudinal distribution, the relation of the count rate to magnetic strength, and the latitudinal distribution are correlated with primary cosmic rays. (R.V.J.)

42339 GEOGRAPHIC POSITION OF THE MAXIMUM PARTICLE DENSITY IN THE OUTER RADIATION BELT AT LOW ELEVATIONS. S. N. Vernov, V. N. Erafeeva, V. E. Nesterov, I. A. Savenko, and P. I. Shavrin. Kosmich. Issled., 2: 289-95(Mar.-Apr. 1964). (In Russian)

The maximum electron density in the outer radiation belt was recorded. The positions of maxima were correlated with the drift trajectories of mirror points and auroral isochasms. The relation between the positions of particle density maxima and geomagnetic field perturbations was analyzed. (tr-auth)

42340 THE ORIGIN OF COSMIC RAYS. Harry Elliot (Imperial Coll. of Science and Tech., London). New Scientist, 23: 447-50(Aug. 20, 1964).

Some possible sources and acceleration mechanisms for cosmic rays are discussed, with consideration of the nature, energy, and distribution of cosmic rays. Acceleration processes involving magnetic fields particularly are considered. (D.C.W.)

42341 ON BURSTS PRODUCED BY MUONS AND ELECTRONS. S. K. Srinivasan and K. S. S. Iyer (Indian Inst. of Tech., Madras). Nuovo Cimento (10), 34: 67-76(Oct. 1, 1964).

The problem of the size fluctuation of bursts produced by muons is considered in the light of the method adopted by us for the evaluation of the mean square deviation of the number of electrons produced in an electron-photon cascade. An explicit simple analytical expression for the mean square deviation of the number of electrons is derived. It is also shown how other problems of experimental interest can be dealt with by the use of multipoint density functions. In particular, sequent correlation functions are used for the bursts produced by electrons. (auth)

42342 HYSTERESIS IN THE VARIATION OF THE INTENSITY OF MULTIPLY CHARGED PRIMARY COSMIC-RAY NUCLEI OVER A SOLAR CYCLE. M. V. K. Apparao (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 34: 241-3(Oct. 1, 1964).

The annual variations of intensity of cosmic helium nuclei and nuclei having $Z \geq 6$ are shown as functions of sunspot activity, for the years 1954 to 1963. The cosmic-nucleus intensity curve has the same form as the sunspot-number curve, but the intensity curve lags the sunspot curve. The lag is more pronounced on the recovery phase of the sunspot cycle than on the decline phase. (T.F.H.)

42343 THEORY OF STREAMING OF COSMIC RAYS AND THE DIURNAL VARIATION. E. N. Parker (Univ. of Chicago). Planetary Space Sci., 12: 735-49(Aug. 1964).

Theory of the motion of charged particles in interplanetary magnetic fields is reviewed for the purpose of understanding the observed net streaming of cosmic rays through interplanetary space. It is shown that the large-scale fields, which often reverse, give no steady streaming by themselves. Small-scale irregularities in the large-scale fields can give steady radial streaming, which in the vicinity of Earth is some small fraction of the solar wind velocity. A large-scale field at the orbit of the Earth with sufficient magnetic irregularity beyond gives an azimuthal streaming with the velocity of rigid rotation with the Sun. It is suggested that this rigid rotation is the origin of the observed diurnal variation. (auth)

42344 COSMIC ELECTROMAGNETIC RADIATION. Everett M. Hafner (Univ. of Rochester, N. Y.). Science, 145: 1263-71(Sept. 18, 1964).

The detection and spectrum of cosmic electromagnetic radiation are discussed, and mechanisms for the production of the radiation are briefly described. Experimental observations are considered in relation to theoretical predictions. (D.C.W.)

Criticality Studies

42345 A DYNAMIC REACTIVITY EFFECT IN COMPRESSIBLE FISSILE MEDIA. Robert Eugene Bailey. Thesis, Lafayette, Ind., Purdue Univ., 1963. 108p.

The behavior of a free neutron population in a medium enclosed within non-reflecting walls is dependent upon the composition of the medium and the size and shape of the enclosure. If the neutrons, on the average, suffer many collisions with the nuclei of the system before escaping into the boundary, it is possible to use the diffusion equation as a means of obtaining the space and time characteristics of the population in question. With this fact in mind, and with tongue in cheek, the effects of periodically changing the size of a given non-reflecting enclosure upon the behavior of the free neutron population inside were studied. Compressible media, from fissile to scattering, were considered. The net outcome was that a "dynamic effect" would occur in a system of free neutrons if the size of the non-reflecting enclosure were periodically changed at a rate greater than the rate with which the system can adjust itself to that change. It was observed from a one dimensional solution of the diffusion equation that a subcritical, compressible fissile system could be made supercritical. This effect can be accomplished by periodically oscillating the enclosure walls through a particular displacement at a particular frequency. (Dissertation Abstr., 25: No. 1, 1964)

Direct Energy Conversion

42346 (AD-432063) RESEARCH, DEVELOPMENT, AND EVALUATION PROGRAM TO DEMONSTRATE PERFORMANCE AND RELIABILITY OF THERMIONIC DIODE CONVERTERS FOR NAVAL NUCLEAR REACTORS. Semiannual Report, June 26—December 31, 1963. (Radio Corp. of America. Special Electronic Components Div., Lancaster, Penna.). Feb. 1964. Contract NObs-88622. 85p.

Efforts were continued to determine life and reliability of a thermionic energy converter designed for operation in a thermal reactor, and to refine the converter design to eliminate causes of failure. Design modifications to permit the inclusion of a fuel sleeve in the emitter of the A-1272 were made, and other modifications to improve converter performance were completed. High-stress and parametric tests were conducted. Detailed fabrication procedures were perfected. A system was established for recording all significant dimensions of converter components during fabrication; these data will be used to determine the extent of structural changes occurring throughout converter life. Twelve converters were tested for high-stress and performance limits, 4 were subjected to extensive life tests, and one to preliminary life testing. The four converters, without nuclear fuel, have operated for a total of 1248 hours on life test without failure. The first fueled converter failed during initial tests as a result of a thermal short caused by the evaporation of fuel onto heater parts. (auth)

42347 (AI-64-48) ANNUAL TECHNICAL SUMMARY REPORT FOR RESEARCH ON PROPERTIES OF HIGH-CURRENT, LOW-FREQUENCY ELECTRODELESS DISCHARGES. C. A. Guderjahn (Atomics International. Div. of North American, Inc., Canoga Park, Calif.). [1963]. Contract FF49(638)-1222. 40p. (AFOSR-64-0999)

Alternating-current, low-pressure electrodeless discharges were excited in cesium, rubidium, potassium, and mercury vapors by magnetic induction. In each case the discharge tube was a toroid forming the secondary of an iron core transformer whose frequency range was 1 to 40 kc. The resistivities of the discharges were measured as a function of current density (1 to 30 amp/cm^2) and pressure (1 to 300 μ). The discharges were diffusion controlled and strongly ionized with electron-charged particle interactions being the principal contribution to resistivity. Resistivities were of the order of 0.2 Ω-cm. (auth)

42348 (GEST-2035) RESEARCH AND DEVELOPMENT PROGRAM OF THERMIONIC CONVERSION OF HEAT TO ELECTRICITY. VOLUME I. Final Technical Summary Report. (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). June 30, 1964. Contract NObs-88578. 172p.

The electrical conductivity of Lucalox alumina was measured under conditions representing the operational environment of a thermionic diode. Tungsten and molybdenum based coatings were developed, metallized to alumina, and tested in cesium vapor for over 2000 hours. Multilayered cermets were prepared but failed to prove electrically insulating. Alumina-to-nickel and alumina-to-niobium shim seals were prepared and tested for extended periods of time. The joining of various refractory metals to metallized alumina using diffusion bonding, brazing, and braze-diffusion bonding techniques were investigated. The cesium corrosion resistance of various materials and seals was determined at 1000°C. (auth)

42349 (NASA-TT-F-240) THE SPIRAL MOTION OF AN ELECTRICALLY CONDUCTIVE GAS BETWEEN COAXIAL PERMEABLE CYLINDERS IN THE PRESENCE OF A LONGITUDINAL MAGNETIC FIELD. I. B. Chekmarev and I. I. Shakhnov. Translated from Zh. Prikl. Mekhan. Tekhn. Fiz., No. 6, 3-6(1963). 8p.

The stationary rotational motion of an electrically conductive gas between infinitely long coaxial cylinders in the presence of an external magnetic field was studied. It is shown that it is the radial component of velocity that determines the blocking effect in a channel, when the continuity of the gas-dynamic parameters of the flow is disrupted. A study of the characteristics of the flow, based on the assumption that there is no blocking in the channel, is presented. (auth)

42350 ENHANCEMENT OF GAS CONDUCTIVITY BY DUST SUSPENSION AND ITS APPLICATION TO CLOSED CYCLE MAGNETOHYDRODYNAMIC POWER GENERATION. M. S. Sodha and E. Bendor (Republic Aviation Corp., Farmingdale, N. Y.). Brit. J. Appl. Phys., 15: 1031-40(Sept. 1964).

The enhancement of the conductivity of a gas by suspension of fine dust of a material of low work function is investigated, together with its application to closed-cycle MHD power generation. It is shown that the dependence of electrical conductivity of a mixture of argon and fine dust of barium oxide (particle diameter 0.05 μm) on pressure, temperature, and λ (the ratio of mass of the dust to that of the gas) is satisfactorily described by a power law. An analysis of the constant Mach number, segmented electrode MHD generator, in which argon with a suspension of barium oxide dust is used as the working fluid, is presented. Finally, a complete steam turbine-magnetohydrodynamic generator binary cycle is analyzed for a range of values of the parameters, and the feasibility of the overall system is discussed. The principal advantages of using the gas-dust suspension as the working fluid are reduction of duct length, low operating temperatures throughout the system and increase in overall efficiency. (auth)

42351 STUDY ON THE THEORETICAL TREATMENT OF LINEAR MHD-DIRECT CURRENT GENERATORS. Rudolf Buecken and Dieter Denzel (Technische Hochschule, Aachen). Elektrotech. Z., 84: 75-80(Feb. 11, 1963). (In German)

The actual thermoelectric transformation processes in which the kinetic energy is evolved as continuously changing energy forms and the gasdynamic processes occurring in the canal of the MHD generator were investigated on the basis of the Shapiro representation of one-dimensional flow. The Ohmic law for the generator canal and for the entire circuit was derived. The differential equations describing the transformation processes were obtained. The effect of independent variables and the mach number on the interaction of the types of energy present was determined. (J.S.R.)

42352 NUCLEAR SOURCES OF HIGH VOLTAGE. M. G. Mitelman, A. A. Kononovich, N. D. Rosenblyum, V. S. Kirsanov, and V. A. Zagadkin. Elektrotekhnika, No. 7, 42-4(July 1964).

The principles of power sources using beta-emitting isotopes are outlined, and the merits of high vacuum and solid dielectric as insulation for such units are indicated. Two types of sources using high vacuum are described—self-contained vacuum sources and sources operating in vacuum objects. (D.C.W.)

42353 MEASUREMENT OF ELECTRON TEMPERATURE IN LOW-PRESSURE CESIUM THERMIONIC ENERGY CONVERTERS. R. A. Chapman, H. J. Caulfield, and H. W. Hemstreet, Jr. (Texas Instruments Inc., Dallas). J. Appl. Phys., 35: 2813-25(Oct. 1964).

The electron distributions incident on the collectors of cesium thermionic diodes were measured, using a d-c probe placed behind a slit in the collectors. The electron temperature was studied for the cases of cesium ion production through surface ionization at the hot, high-work-function emitter and ion production in the cesium vapor by volume ionization. (D.C.W.)

42354 THERMIONIC WORK FUNCTION OF THIN-OXIDE-COATED ALUMINUM ELECTRODES IN VACUUM AND IN CESIUM VAPOR. Richard A. Chapman (Texas Instruments Inc., Dallas). J. Appl. Phys., 35: 2832-43 (Oct. 1964).

The thermionic work function of Al electrodes with anodized aluminum oxide coatings of 30 and 2000 Å was determined for each electrode from the contact potential difference of each electrode with a well outgassed and aged polycrystalline W wire emitter. In vacuum, the thermionic work function of the 30-Å coated electrode was 4.3 ± 0.1 ev, relative to a polycrystalline W work function of 4.6 ev and a W emission constant of 120 amp/$cm^2 \cdot {}^\circ K^2$. In Cs vapor at reservoir temperatures up to 70°C, the 30-Å coated electrode had a minimum observed work function of 1.4 ± 0.1 ev relative to the same W reference electrode. The resistance of the 2000-Å film coated collector electrode was too large to allow accurate determination of the work function of this electrode. In both vacuum and Cs vapor, however, there was an indication that the work function of the 2000-Å coated electrode was a few tenths of an electron volt lower than that for the 30-Å coated electrode. It is suggested that similar but perhaps less stable oxide-coated electrodes could occur naturally on the collector of a thermionic energy converter due to oxidation of the collector surface or buildup on the collector surface of outgassing products from the emitter. Auxiliary experiments were performed on the secondary-electron emission from these oxide-coated electrodes. No lingering secondary electron emission current corresponding to a Malter effect was observed. The true secondary yield from the 2000-Å coated electrode was 3 in vacuum and 7 in Cs vapor for a primary electron energy of 150 ev. The secondary yield for the 30-Å coated electrode was similar in Cs vapor, but was not studied in vacuum. (auth)

42355 ESTIMATION OF CONTACT POTENTIAL DIFFERENCES IN THERMIONIC ENERGY CONVERTERS. H. J. Caulfield (Texas Instruments Inc., Dallas). J. Appl. Phys., 35: 2862-9(Oct. 1964).

The contact potential difference in a low-pressure thermionic energy converter can be written as CPD = $\tilde{\varphi}_E - \tilde{\varphi}_C$, where $\tilde{\varphi}_E$ and $\tilde{\varphi}_C$ are averaged work functions of the emitter and collector, respectively. The estimation of $\tilde{\varphi}_E$ and $\tilde{\varphi}_C$ from existing work-function data is discussed. As an example, $\tilde{\varphi}_E$ values are estimated for well-aged polycrystalline tungsten wire, and those estimates are compared with experimental values. (auth)

42356 CESIUM-IMPREGNATED INERT GAS DIODES. R. Forman and J. R. Reiss (Union Carbide Corp., Parma, Ohio). J. Appl. Phys., 35: 2885-6(Oct. 1964).

The characteristic curves for diodes were measured using different ambient fillings. Higher currents were obtained with a mixture of Cs and Xe at appropriate pressures than with either gas alone. Negative-resistance diodes resulted with Xe in the appropriate temperature range plus Cs. (D.C.W.)

42357 NONEXISTENCE OF DC STATES IN LOW-PRESSURE THERMIONIC CONVERTERS. Peter Burger (Stanford Univ., Calif.). J. Appl. Phys., 35: 3048-9 (Oct. 1964).

By computer simulation of the operation of a low-pressure thermionic convertor, it was established that, at least for the case of large currents through the converter, no d-c states exist; and the state of the diode has large amplitude oscillations at all times. (D.C.W.)

42358 A THEORETICAL STUDY OF MHD POWER GENERATION. I. ELECTRIC FIELD DISTORTION DUE TO HALL EFFECT. Itaru Michiyoshi, Kunihiko Uematsu, and Masahiro Numano (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 1: 147-54(Aug. 1964).

The current and electric field distributions in the entrance and exit regions of a linear MHD power generator are analyzed for the case in which the working fluid (gas) exhibits the Hall effect. Solutions are presented in closed form for several values of the Hall parameter, showing that the electric potential in the entrance plane assumes an extreme value between the electrodes and that the length of the "entrance region" is of the same order as the distance between the electrodes. The influence of electric field distortion at the entrance on the current and electric field distributions is negligible beyond this region. The electric field distortion occurs in the exit region also, resulting in an "end loss." (auth)

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Refer also to abstracts 42297, 42627, and 42716.

42359 (AD-600270) FEASIBILITY STUDY OF EM GENERATOR. S. L. Ruby (Westinghouse Electric Corp. Westinghouse Defense and Space Center, Baltimore). Dec. 1963. Contract AF33(657)-9588. 66p. (RTD-TDR-63-4168)

In hopes of achieving laser-like action for gamma radiation, the stimulated emission of gamma rays, a prerequisite but easier task, was studied. Studies indicate that although there is no theoretical difficulty, even the mere demonstration of this effect in actual cases lies beyond present capabilities. In support of this conclusion, two experiments are discussed. Both use nuclear absorption, rather than the theoretically almost identical stimulated emission process. The first experiment performed shows that the lifetime of a nuclear state depends on the entire system in which the nucleus is placed. The second experiment, performed in Russia and reported in the U. S. in early September 1963, demonstrated that the nuclear resonance absorption process can just be barely detected in a nucleus whose half life is 63 seconds. As anticipated, the probability for this process is decreased by various line broadening mechanisms approximately six orders of magnitude below simple expectations. The observed effect is barely above statistical fluctuations. It is concluded that in the best possible case, nuclear lifetime lengthening due to absorption can be barely observed, and that nuclear lifetime shortening-stimulated emission is more difficult to observe by a factor of at least 10^7. (auth)

42360 (AD-605305) A MEASUREMENT OF PROTON-PROTON POLARIZATION AND TRIPLE SCATTERING PARAMETERS D, R, A, AND A′ AT 430 Mev (thesis). Technical Report No. 33. Richard F. Roth (Princeton Univ., N. J.). July 30, 1964. Contract Nonr-1858(06). 100p.

The polarization parameters P, D, R, A, and A′ were measured at 7 scattering angles between 30 and 120° in the center-of-mass with an incident energy of 430 Mev. A 56% polarized beam was prepared by scattering on an internal beryllium target in the Chicago Synchrocyclotron. A liquid-hydrogen target was used for the p-p scattering and the outgoing polarization was analyzed with a third scattering in the carbon plates of a spark chamber. The scattering asymmetry, ϵ, was determined by fitting the data to a distribution of $1 + \epsilon \cos \theta$ by the maximum-likelihood method. The analyzing power of the spark chamber as a function of energy was measured in beams of known polarization. The beam polarization before and after the p-p scattering was manipulated with a solenoid and two bending magnets. During a 5-week run, 1.4×10^6 pictures were taken. The pictures were scanned and measured on angular encoding machines with a least count of ⅓ degree. The measurements are compared with the extrapolations of several phase shift and resonance analyses of experimental data at higher and lower energies. (auth)

42361 (BNL-8315) π^+p CROSS SECTIONS BELOW 4 Gev. F. E. James, J. A. Johnson, and H. L. Kraybill (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 9p. (CONF-550-52)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A compilation of elastic and inelastic cross sections (including those for production of resonances) of π^+ in hydrogen is presented. Results of experiments at 1.76 and 2.08 Bev/c including elastic scattering angular distributions are presented. (auth)

42362 (CERN-64-40) ON THE PRODUCTION OF ANTIDEUTERONS. H. Pilkuhn (European Organization for Nuclear Research, Geneva). Sept. 14, 1964. 19p.

The production of antideuterons in proton-proton and -antiproton interactions, and in reactions of protons, deuterons, and alpha particles with nuclei was studied. (R.E.U.)

42363 (CEX-62.14) AN EXPERIMENTAL INVESTIGATION OF THE SPATIAL DISTRIBUTION OF DOSE IN AN AIR-OVER-GROUND GEOMETRY. F. F. Haywood, J. A. Auxier, and E. T. Loy (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract [W-7405-eng-26]. 124p.

The experimental study described was conducted in an effort to expand the present knowledge of the effect of the presence of the air-ground interface on the measurement of neutron first collision tissue dose and gamma-ray exposure in air above the earth's surface. Measurements of neutron dose were made in radiation fields from the Health Physics Research Reactor (HPRR) operating at steady-state power and supported at several heights above the earth's surface. Measurements of gamma-ray exposure were made in radiation fields from the HPRR and from a ^{60}Co source supported in a similar geometry. To substantiate the experimental data, comparisons were made to data which were collected during nuclear weapons tests. Values of relaxation length for neutron dose and gamma-ray exposure were compared in both cases with satisfactory agreement. Several comparisons of experimental data have been made with computed data. Ritchie has computed boundary correction factors K, for neutrons, for a series of source-detector geometries. In comparing experimentally determined boundary correction factors K(exp), for neutrons, with computed values K, ±10 percent agreement was obtained from a slant range of 100 meters to a slant range of 1000 meters. Ritchie and French have computed the decrease in the infinite medium neutron dose, at large slant ranges, caused by the presence of the air-ground interface. A comparison was made between these values and experimental data, but it was not found to be acceptable. It is recommended that a careful study of this comparison be made when more experimental and theoretical data are available. Experimental values of dose as a function of detector height were compared to French's computed values, indicating ±2 percent agreement from 10 feet to 100 feet above the interface and ±6 percent at the interface. Berger has computed boundary correction factors K for ^{60}Co gamma rays. Experimental determination of K(exp) for ^{60}Co are compared to values of K. In this case, the comparison indicates that Monte Carlo techniques may be used successfully to predict the effect of the presence of the air-ground interface on calculations of exposure at large distances ($R > 600$ feet) from a point isotropic gamma-ray source, to within <2 percent. It was found that for most points in the finite medium, the ratio, neutron dose to gamma-ray exposure is independent of the height of the fission source above the air-ground interface. It was experimentally determined that, in general, the presence of the air-ground interface enhances the measured radiation at slant ranges close to the source and decreases the measured radiation at large slant ranges. That is to say, for a given source height near the ground, and for a fixed detector height, K(exp has a value of one for some unique slant range. However, as the height of the source increases, the slant range at which K(exp) = 1 also increases. (auth)

42364 (IA-969) SPIN TESTS FOR THE Ω^- PARTICLE. Y. Dothan (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth). June 1964. 20p.

Spin tests for Ω^-, produced in the reaction $p + \bar{p} - \Omega^- + \overline{\Omega^-}$, are proposed. The tests are in the form of a set of inequalities satisfied by the angular distributions of the decay products. (auth)

42365 (JINR-E-1790) STRANGE PARTICLE PHYSICS (EXPERIMENTAL). D. Miller (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 37p. (CONF-550-64)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A review is presented of papers on properties of the baryon octet, hyperon-nucleon scattering at low momentum, meson (K^-)-proton interactions at high momentum, strange-particle production in p-$\bar{p}$ interactions at 6.74 Bev/c, strange-particle production in p-$\bar{p}$ interactions at 5.5 Bev/c, and uses of the exchange model. (R.E.U.)

42366 (JINR-E-1802) INTERACTIONS OF PIONS AND NUCLEONS ABOVE 1 Gev/c. S. J. Lindenbaum (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 49p. (CONF-550-77)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A review is presented of papers on experimental and theoretical aspects of pion-nucleon interactions at high energies. (R.E.U.)

42367 (JINR-E-1803) NEUTRINO PHYSICS (EXPERIMENTAL). G. Bemardini (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 39p. (CONF-550-70)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A review is presented of papers on experimental aspects of neutrinos, both muon- and electron-associated. (R.E.U.)

42368 (JINR-E-1804) STRANGE PARTICLES RESONANCES (EXPERIMENTAL). R. Armenteros (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 42p. (CONF-550-76)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A review is presented of papers on strange (5 ± 0) particle resonances. Resonances involving K mesons and one, two, or three pions are reported. Hyperon resonances are also included. 30 references. (R.E.U.)

42369 (JINR-P-1692) MYAGKIE FOTONY V PROTSESSAKH S ELEMENTARNYMI CHASTITSAMI. (Low-Energy Photons in Elementary Particle Collisions). L. D. Soloviev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 24p.

General equations of the local field theory (including quantum electrodynamics in all orders in e) were used to obtain the first two terms in the series expansion of the bremsstrahlung matrix element in the momenta of the soft photons. For bremsstrahlung of one photon with momentum k the first term of this expansion is of order k^{-1}, the second one is of order $e^2 \ln k$, and the third term is of order k^0. The coefficients of the first and second terms are proportional to the matrix element for the corresponding process without emission of the soft photons. With the aid of this expansion the first two terms in the series expansion of the bremsstrahlung cross section in the radiated energy are obtained. A term of order $k^2 \ln k$ in the series expansion of the total cross section for scattering of a photon with momentum k by a charged particle is found. It is shown that the imaginary part of the elastic Compton scattering amplitude at fixed momentum transfer is a generalized power function of the energy s near the threshold $s = m^2$. The first term in the expansion of the amplitude in powers of $s - m^2$ is found and the next term is estimated. It is shown that the factorization of infrared divergence of any scattering amplitude follows from simple physical considerations and the spectrality condition. (auth)

42370 (JINR-P-1723) ANALIZ ZAPRESHCHENNYKH KONFIGURATSII V $\Lambda\pi\pi$-REZONANSE. (An Analysis of Forbidden Configurations in $\Lambda\pi\pi$). Wong Dyk Tao, Ti Kao, and G. I. Kopylov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 6p.

The forbidden configurations in the $\Lambda\pi\pi$ system that are dependent on spin, parity, and the isospin of the system are found. The proof is general and independent of a concrete form of the matrix element. (auth)

42371 (JINR-P-1750) SUSHCHESTVUYUT LI NOVYE LEGKIE NEITRALNYE MEZONY? (Do There Exist New Light Neutral Mesons?) V. G. Grishin and G. I. Kopylov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 13p.

The properties of hypothetical neutral mesons (L) are treated for which the decays into other particles via weak and strong interaction are forbidden. It is shown that some L-mesons may have long lifetime ($\tau \approx 10^{-5}$ to 10^{-8} sec) because the decays into 3 or 4γ–quanta are the only possible ones for these mesons. Besides, there is a region of masses and sets of quantum numbers of L–mesons when the decay $L \rightarrow \pi\pi\gamma$ is the main one. (auth)

42372 (JINR-P-1809) ZAKLYUCHITEL'NYE ZAMECHANIYA PREDSEDATELYA KONFERENTSII. (Final Remarks by D. I. Blokhintsev, Chairman of the Conference). D. I. Blokhintsev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 8p. (CONF-550-61)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Papers presented on strong interactions, small-angle π-N scattering, and the virtual part of scattering amplitudes at high energies are briefly reviewed. (R.V.J.)

42373 (NASA-CR-53233) THREE-PARTICLE SCATTERING. II. IN SPACE. R. C. Whitten (Stanford Research Inst., Menlo Park, Calif.). [1963]. 25p. (N64-17577)

The theory of three-particle collisions in a plane that was developed in an earlier paper (see NSA, 17: 28177) is extended to scattering in space. Formal expressions for scattering amplitudes and cross sections are obtained for inelastic and rearrangement collisions as well as for elastic scattering. The optical theorem is also extended to the three-body case. A discussion of the dynamics of a collision among three structureless particles that interact via a short-range potential is given. (auth)

42374 (NP-14243) VESHCHESTBENNAYA CHAST AMPLITUDY P-P RASSEYANIYA VPERED PRI BOLSHIKH ENERGIYAKH. (Real Part of the p-p Forward Scattering Amplitude at High Energies). I. I. Levintov and G. M. Adel'son-Bel'skii (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 7p.

The real part of p-p forward scattering amplitudes, averaged according to their spins, was calculated on the basis of twice-subtracted dispersion relations. Comparisons of the magnitudes $[\mathrm{Re}A^{pp}(0)/\mathrm{Ym}A^{pp}(0)]^2$ with experimental data on $(d\sigma/d\Omega)_0$ showed that for 24.5 Bev [in which an increase of $(d\sigma/d\Omega)$ over the optical limit was not observed] the values were difficult to correlate to the Brookhaven results for $E_p \sim 10$ Bev without considering the spin terms. Correlations with $\mathrm{Re}A^{pp}(0)$ calculations based on once-subtracted dispersion relations predict that the difference $\sigma_t^{pp} - \sigma_t^{pp}$ is actually very small even at ~40 Bev. (tr-auth)

42375 (SAL-3) THE PHOTON SPECTRUM FROM POSITRON ANNIHILATION IN FLIGHT (thesis). Russell Virley Elliott, K. Lokan, D. Lobb, and L. Katz (Saskatchewan. Univ., Saskatoon. Saskatchewan Accelerator Lab.). Apr. 1964. 184p.

Submitted by Russell Virley Elliott.

The shape of the photon spectrum due to the annihilation of positrons in flight was calculated. Multiple scattering and energy losses of the positrons before annihilation were taken into account in the calculation. It was found that multiple scattering tends to narrow, rather than broaden, the photon spectrum. Calculations are done to show that this result is to be expected. A computer program is given for the numerical evaluation of pertinent integrals. (auth)

42376 (TID-20762) MESON RESONANCE PRODUCTION π^+-d INTERACTIONS AT 1.23 Bev/c. Robert Kraemer (Johns Hopkins Univ., Baltimore), Thomas Fields (Northwestern Univ., Evanston, Ill.), Timothy Toohig, et al. (Woodstock Coll., Md. Research Inst. for the Natural Sciences). [1964]. Contract [AT(30-1)-1447]. 45p.

A report is made of the study of production and decay properties of the η^0, ω^0, ρ^0, and π^0 mesons produced in π^+-d collisions at 1.23 Mev/c in a 72″ bubble chamber. The production processes were analyzed in terms of π^+-neutron interactions through the use of an impulse model. A clear enhancement due to the $N^*_{1/2}$ (1668) resonance is observed in the π^0 (charge-exchange) production cross section. The mass of the η^0 meson is found to be 552 ± 3 Mev with a branching ratio of $(\eta^0 \rightarrow \text{all neutrals})/(\eta^0 \rightarrow \pi^+\pi^-\pi^0) = 3.6 \pm 0.8$, and the partial width $\Gamma(N^*_{1/2}\ (1668) \rightarrow p + \eta^0) < 2$ Mev. The central value of the ω^0 meson peak is found to be 781 ± 2 Mev, with a branching ratio $(\omega^0 \rightarrow \text{all neutrals})/(\omega^0 \rightarrow \pi^+\pi^-\pi^0) = 8 \pm 3\%$, and an upper limit of 5% for decay into two charged pions. The production of the ω^0 is found to be inconsistent with the single-vector-meson exchange model. (auth)

42377 (TID-21014) HIGH-ENERGY PHYSICS PROGRAM ANNUAL REPORT, SEPTEMBER 1963–SEPTEMBER 1964. (Pennsylvania. Univ., Philadelphia). June 1964. Contract AT(30-1)-2171. 38p.

Theoretical research covering a broad spectrum of problems involving nearly all branches of elementary physics is summarized. Work on low-energy nuclear theory and many-body problems is also reported. Most of the theoretical work is reported in published papers. Experimental research progress is reported on strange particle beta decay, double beta decay, operation and use of stainless steel mesh spark chambers, studies of multi-particle resonances, π^-–proton interactions at 3 Bev, search for fractionally charged particles, elastic backward scattering in π–proton interactions at high energies, π^-–proton interactions at 6 to 8 Bev, and an automatic analysis program for high-speed particle track-chamber measurements. (J.R.D.)

42378 (UCRL-7846) ENERGY-DEPENDENT PION-NUCLEON PHASE-SHIFT ANALYSIS; 0–700 Mev, $\ell_m = 4$ SOLUTION. L. David Roper and Robert M. Wright (California. Univ., Livermore. Lawrence Radiation Lab.). June 4, 1964. Contract W-7405-eng-48. 87p.

The equations used in an energy-dependent pion-nucleon phase shift analysis are listed. A list of pion-nucleon scattering data references is included. The best solution obtained using $\ell_m = 4$ for a selected set of 0- to 700-Mev data is given and graphical comparisons between the solution and the data are given. This solution's predictions for observables that have not yet been measured are given. There are three resonances in this solution: P_{33} at 193 Mev laboratory kinetic energy (mass = 1234 Mev); P_{11} at 575 Mev (mass = 1497 Mev); and D_{13} at 638 Mev (mass = 1534 Mev). (auth)

42379 (UCRL-11446) STUDY OF THE K^+p INTERACTION FROM 0.85 TO 1.5 Bev/c. John L. Brown, Roger W. Bland, Michael G. Bowler, Gerson Goldhaber, Sulamith Goldhaber, Allan A. Hirata, John A. Kadyk, Victor H. Seeger, and George H. Trilling (California. Univ., Berkeley. Lawrence Radiation Lab.). July 22, 1964. Contract W-7405-eng-48. 8p. (CONF-550-45)

From the International Conference on High Energy Physics, Dubna, USSR, Aug. 1964.

Preliminary results of cross section measurements and resonance identification are given for various K^+p reactions in a 25-inch hydrogen bubble chamber for K^+ momenta of 0.86, 0.96, 1.20, 1.36, and 1.58 Bev/c. (R.E.U.)

42380 (UCRL-11526) ELASTICALLY SCATTERED POLARIZATION OF 40-Mev PROTONS FROM DEUTERIUM (thesis). Howard S. Goldberg (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 5, 1964. Contract W-7405-eng-48. 72p.

The polarization of the elastically scattered protons from deuterium at 40 Mev was measured and found to be large, reaching a maximum negative value of −0.392 ± 0.018 at $\theta_{\text{cms}} = 114$ deg and crossing over to positive values at backward cms angles. The results do not agree with the impulse-approximation predictions of Kowalski and Feldman. After development of the density-matrix formalism for a spin ½, spin 1 system, a phase-shift analysis of the data was made, using the elastic differential cross section results of Williams. To get a reasonably good fit to the data, F waves had to be included. This required a 26-parameter fit, and for 62 data points gave a minimum χ^2 of 135. The large values of the mixing parameters in certain J states indicate the presence of tensor forces. (auth)

42381 (UCRL-11547) FORM FACTORS IN $K^+_{\mu3}$ DECAY. George Gidal, Wilson M. Powell, Robert T. Pu, Carl Sandler (California. Univ., Berkeley. Lawrence Radiation Lab.), Ugo Camerini, W. F. Fry, Ronald Hantmann, Robert March, David Murphree (Wisconsin. Univ., Madison), and Sergio Natali (Bari, Italy. Universita. Istituto di Fisica). July 2, 1964. Contract W-7405-eng-48. 11p. (CONF-550-81)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

An analysis of $K^+_{\mu3}$ events in a 30-in. C_3F_8-filled chamber exposed to stopping K^+ from the Bevatron is presented. A universal V-A Fermi interaction with μ-e universality is assumed. (R.E.U.)

42382 (UCRL-11576) NEUTRAL FINAL STATES IN π^-p INTERACTIONS FROM 500 TO 1300 Mev. Vincent Z. Peterson, Robert J. Cence, Victor J. Stenger (Hawaii. Univ., Honolulu), Charles B. Chiu, Richard D. Eandi, Robert W. Kenney, Burton J. Moyer, John A. Poirier, and W. Bruce Richards (California. Univ., Berkeley. Lawrence Radiation Lab.). July 1964. Contract W-7405-eng-48. 9p. (CONF-550-82)

From The International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Total cross sections and angular distributions were measured for π^--p interactions at 531 to 1308 Mev. Production of η^0 and single and multiple π^0 was studied. Measurements were made in a 4π spark chamber array. (R.E.U.)

42383 Mu MESON LIFETIME. Am. J. Phys., 32: XV(Oct. 1964).

An experimental method to determine the lifetime of the meson (μ) is outlined. (C.E.S.)

42384 AN INTRODUCTION TO DISPERSION RELATIONS. C. H. Holbrow and W. C. Davidon (Haverford Coll., Penna.). Am. J. Phys., 32: 762-74(Oct. 1964).

The concepts of causality, linearity, time symmetry, unitarity, and crossing symmetry and their relation to dispersion relations are discussed. Dispersion relations are applied to some simple electric circuits in order to illustrate some of their properties and then a simple example is given of the use of dispersion relations for the analysis of the forward angle scattering of pions on protons. (auth)

42385 SOME CONSEQUENCES OF THE ISOSPIN COMMUTATION RELATIONS FOR ISOVECTOR FORM FACTORS. Wolfgang Kummer (Universität, Vienna), Herbert Pietschmann, and A. P. Balachandran. Ann. Phys. (N. Y.), 29: 161-74(Sept. 1964).

The equal-time commutation relation for the isospin density and its consequences for the isovector form factors of the nucleon are investigated. The functional equations for the form factors which were previously derived in the one-nucleon approximation are partly solved in closed form. The next term of the series, the π-N intermediate state, is completely solved, yielding a connection between the amplitudes for the electroproduction of pions and the isovector form factors. (auth)

42386 PAIR PRODUCTION ON THE BASIS OF HOLE THEORY WITHOUT DIRAC MATRICES. Birendra Nath Paria (Inst. of Theoretical Physics, Calcutta). Indian J. Theoret. Phys., 6: 69-76(Sept. 1958).

The differential cross section for the creation of a pair of electron and positron by γ rays in the presence of a nucleus was deduced in a simple and straightforward manner taking Dirac's idea of hole but without using his matrices. This new method is a general one and can be applied successfully to all radiation problems. (auth)

42387 NOTE ON THE WAVE-STATISTICAL DERIVATION OF KLEIN-NISHINA FORMULA FOR COMPTON SCATTERING. K. C. Kar and B. N. Paria (Inst. of Theoretical Physics, Calcutta). Indian J. Theoret. Phys., 7: 57-60(Sept.-Dec. 1959).

The wave-statistical theory of the Klein-Nishina formula and the mechanisms of the different processes involved were critically discussed. (auth)

42388 ON THE MASS DIFFERENCE IN ISOTOPIC MULTIPLICITIES. Yu. M. Aivazyan (Central Research Inst., Academy of Sciences, Armenian SSR). Izv. Akad. Nauk Arm. SSR, Ser. Fiz. Mat. Nauk, 17: 115-17(1964). (In Russian)

The formula derived by S. Okubo (Progress Theor. Phys., 27: 949(1962)) for the mass of particles obtained by the transformation of the SU(3) group agreed well with experimental data; the interaction considered was invariant with respect to the strong subgroup of the SU(3) group. The formula relates to the first order of strong interactions in the perturbation theory. This question was further examined for the case involving mass division of isotopic multiplets of particles transformed according to the representation $D^8(1,1)$ and $D^{10}(3,0)$ of the SU(3) group. As an example, $(T_1^1 + \alpha)^2 + \beta$, where α and β are constants, was used as the interaction causing degeneracy of the isotope mass multiplets. On the basis of the derivation, the relation between mass differences was obtained. The relation is valid for any given dependence of the interaction on T_1^1. (TTT)

42389 PARTICLE RADIATION FROM THE END OPENING OF A WAVEGUIDE. B. M. Bolotovskii and D. M. Sedrakyan (Central Research Inst., Academy of Sciences, Armenian SSR). Izv. Akad. Nauk Arm. SSR, Ser. Fiz. Mat. Nauk, 17: 119-26(1964). (In Russian)

When a charged particle passes through the open end of a semi-infinite metallic waveguide, a part of the field is broken away and is propagated in the form of electromagnetic radiation. Such radiation, generated by the movement of a particle in a direction parallel with the axis of a cylindrical waveguide was examined more closely. The system considered was curved and was open at one end, possessing an ideally conducting and infinitely thin wall. It was assumed that the resulting radiation was so weak that the changes in the velocity of the particle may be neglected. The Maxwell equations were solved by considering the system as the sum of the field due to the motion of the particle in vacuum and of another field, created by the currents induced by the charged particles at the lateral surface of the waveguide. A formula was obtained for use in determining when the radiation losses reach a maximum or minimum value. (TTT)

42390 EMISSION OF VAVILOV-CHERENKOV RADIATION BY LINEAR CHARGES AND FINITE DIMENSION BEAMS IN OPTICALLY ACTIVE MEDIUM. E. D. Gazazyan and O. S. Mergelyan. Izv. Akad. Nauk Arm. SSR, Ser. Fiz. Mat. Nauk, 27: 105-12(1964). (In Russian)

Studies were made of Vavilov-Cherenkov emission of linear charges and finite beams in isotropic optically active media, and equations were developed for the fields and energy losses. The radiation spectrum and polarization were analyzed, and the relation between charge magnitude and emission spectrum were found. With $\alpha \to 0$ the results are in good agreement with those of B. M. Boltovskii, et al. (Optics and Spectroscopy, 14: 3, (1963)). (R.V.J.)

42391 FOCUSING POSSIBILITIES WITH ROTATIONALLY SYMMETRICAL ELECTRON-BEAM SOURCES. Karl-Joseph Hanszen (Physikalisch-Technische Bundesanstalt, Brunswick). Naturwissenschaften, 51: 379-80 (1964). (In German)

Methods of focusing electron beams from rotationally symmetric sources are discussed. Parabolic axial point focusing was described by a horizontal passage of the image curve through the coordinates origin and cone focusing by curve fragments, which touch the abscissa axis beyond the origin. (M.C.G.)

42392 A COMPUTER METHOD FOR ANALYSING GAMMA RAY SCINTILLATION SPECTRA. K. Loew (Research Inst. of National Defence, Stockholm). Nucl. Instr. Methods, 27: 335-7(July 1964).

A least-squares method of analyzing gamma scintillation spectra, consisting of contributions from known nuclides, is described. The computations were performed on an IBM-7090 computer. (auth)

42393 A COMMENT TO A. SCHAARSCHMIDT: INTERPOLATED ENERGY DISTRIBUTIONS OF Cs^{137} GAMMA RAYS SCATTERED IN WATER. Chr. Sybesma (Academic Hospital, Leiden). Nucl. Instr. Methods, 27: 341(July 1964).

Discrepancies in experimentally determined scattered gamma energy distributions are discussed. It was concluded that variations in both the interpolation results and the reproduced measured pulse height distributions could be due to the dimension of energy (M_0C^2) used. Errors in the non-diagonal elements of the inverted escape matrix are also discussed. (M.C.G.)

42394 A STUDY OF NUCLEON-NUCLEON PHASE-PARAMETERS USING DEUTERON PHOTODISINTEGRATION. A. Donnachie (University Coll., London) and P. J. O'Donnell. Nucl. Phys., 59: 385-97(Oct. 1964).

Following a recent treatment of some aspects of the photodisintegration of the deuteron, the process is used to study nucleon-nucleon phase parameters. Retardation effects are included and phenomenological wave functions are used throughout. The phase parameters used are those of Breit et al., and two main sets are considered, namely, YLAM and YRBI, the p-p scattering sets, each of which can be subdivided into four subsets when taken with the n-p scattering sets YLAN3M, YLAN3, YLAN2M, and YLAN2. To allow for the uncertainty in D-state probability the calculations are carried out for both 4% and 6% D-state probabilities. The results are compared with experiment and the YLAM group is favored. No discrimination can be made among the n-p subsets of the YLAM group. (auth)

42395 SOME OBSERVATIONS ON TRANSVERSE MOMENTUM OF CHARGED PIONS EMITTED IN π^--NUCLEON COLLISIONS AT 4.4 Gev. P. K. Malhotra (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., 59: 551-60 (Nov. 1964).

The distribution of transverse momentum p_t of charged pions produced in pion-nucleon collisions at 4.4 Bev was obtained. The distribution has a relatively broad maximum, centered at $p_t \approx 200$ Mev/c with $\langle p_t \rangle = 300 \pm 23$ Mev/c. It is found that $\langle p_t \rangle$ for charged pions increases with the angle of emission up to about 10–15°, beyond which it has a constant value. Further, the transverse momentum seems to be independent of multiplicity. It is pointed out that while in proton-nucleon collisions, $\langle p_t \rangle$ for charged pions decreases gradually from 350 Mev/c at 24 Bev to as low as 142 Mev/c at 4.2 Bev, in pion-nucleon collisions it shows much less variation, viz., it decreases from 360 Mev/c at 16 Bev to only 300 Mev/c at 4.4 Bev. These features can be understood reasonably well on the hypothesis that a majority of the pions at these energies result from resonance states. (auth)

42396 A MODEL FOR MESON-BARYON SCATTERING. R. W. Lardner. Nucl. Phys., 59: 593-600(Nov. 1964).

A previous model for low-energy pion-nucleon scattering is extended to the case of mesons and baryons which belong to eightfold representations of SU_3. (auth)

42397 DEVELOPMENT OF MODERN PHYSICS IN ITS RELATION TO RESEARCH ON ELEMENTARY PARTICLES. Victor F. Weisskopf (CERN, Geneva). Nucleus (Paris), 5: 174-82(May-June 1964). (In French)

The developments that have resulted from recent research on elementary particles are briefly reviewed, and it is shown how such developments are integrated within the frame-work of modern physics. The appropriate concepts of modern field theory are outlined. (D.C.W.)

42398 A NOTE ON THE TRANSVERSE MOMENTUM OF SECONDARY PARTICLES. E. Lohrmann (Deutsches Elektronen-Synchrotron, Hamburg). Nuovo Cimento (1), 1: 1226-9(1963).

The transverse momentum of secondary particles emitted from high-energy nuclear interactions that can be estimated from the interactions produced by these secondary particles is discussed. The method for determining the momentum is briefly outlined, and the uncertainty of the energy determination is considered. (C.E.S.)

42399 INELASTICITY AND MESON EMISSION ASYMMETRY IN HIGH-ENERGY JETS. B. Hildebrand and R. Silberberg (Naval Research Labs., Washington, D. C.). Nuovo Cimento (1), 1: Suppl. No. 4, 1118-42(1963).

The set of p and n primary events were analyzed in terms of inelasticity. The mirror inelasticity (K_M) distribution was compared with the laboratory inelasticity (K_L) distribution, and the difference is interpreted as evidence for asymmetric particle emission in the nucleon-nucleon cms. The Castagnoli energy estimation method was modified by utilizing the electromagnetic cascade data, yielding E_c' as the modified Castagnoli energy. The emitted energy $(E_\gamma + E_{ch})$ is discussed, and the integral energy spectrum of $(E_\gamma + E_{ch})$ is found to have the slope of the cosmic ray energy spectrum, as expected. The symmetrized emission-center coordinate system is used to relate asymmetry to the ratios of K_L/K_M and E_c'/E. It is also shown that $K_M = (E_\gamma + E_{ch})/E_c'$. The experimental K_M distribution is investigated, and systematic differences between events with high and low K_M values are explored. The experimental mirror and calculated laboratory inelasticity distributions are compared, and the difference is interpreted in terms of asymmetry. The emitted energy in the emission-center system is used to calculate the number of shower tracks for the symmetric as well as for the asymmetric events, and the calculations are compared with experimental results. The nucleon-core and pion-cloud interaction model is considered as a possible explanation for asymmetry. (C.E.S.)

42400 ON FOUR-MOMENTUM TRANSFER IN HIGH-ENERGY ELEMENTARY COLLISIONS. G. Fujioka (Univ. of Kobe, Japan), Y. Maeda, O. Minakawa, et al. Nuovo Cimento (1), 1: Suppl. No. 4, 1143-56(1963).

A procedure for the estimation of four-momentum transfer in meson-producing interactions of cosmic nucleons is outlined, and the results are compared with the multiperipheral model theory. (C.E.S.)

42401 ON AN INTERESTING REGULARITY IN THE MULTIPLICITY FREQUENCY DISTRIBUTION OF I.C.E.F. SECONDARY EVENTS. C. L. Deney (Louisiana State Univ., Baton Rouge). Nuovo Cimento (1), 1: Suppl. No. 4, 1188-96 (1963).

The interactions of secondary particles with nucleons of the emulsion nuclei are discussed. Assuming single-nucleon targets, i.e., no cascading, one might expect for the interaction of charged secondaries a slight excess of events having odd n_s and for the interaction of neutral secondaries a slight excess of events having even n_s, where n_s is the number of charged particles emanating from the secondary interaction. It is pointed out that in the group of secondaries having $N_h = 3, 4, 5$, and 6, $n_s \geq 7$, and mean energy of 500 Bev that this is clearly not the case. (C.E.S.)

42402 DESCRIPTION OF CHARACTERISTICS OF HIGH-ENERGY NUCLEAR INTERACTIONS AND ISOBAR DECAY PRODUCTS. K. Imaeda and M. Kazuno (Inst. for Advanced Studies, Dublin). Nuovo Cimento (1), 1: Suppl. No. 4, 1197-1225(1963).

A description of the characteristics of the individual jets with respect to various quantities such as inelasticity of collision K_b, momentum of interaction ΔP, and so on, which are derivable from γ_c, σ, and n_s based on the two-fireball model, Γ_- which is a characteristic quantity in the π-N interpretation of N-N collision, and γ_{N^*} which is derivable from the isobar model. (C.E.S.)

42403 NEUTRON-PROTON INTERACTIONS IN THE ENERGY RANGE (290 ÷ 970) Mev. J. G. Rushbrooke (Cambridge Univ., Eng.), D. V. Bugg, A. J. Oxley, J. A. Zoll, M. Jobes, J. Kinson, L. Riddiford, and B. Tallini. Nuovo Cimento (10), 33: 1509-37(Sept. 16, 1964).

A study of inelastic n-p interactions was made using the 1 Bev synchrotron and a 9 in. diameter liquid hydrogen bubble chamber. The 1840 three-pronged events initiated by neutrons in the energy range (290 – 970) Mev were analyzed, the possible reactions being: $n + p \rightarrow p + p + \pi^-$, n +

$p \rightarrow n + p + \pi^0$, $\pi^0 \rightarrow e^+ + e^- + \gamma$, and $n + p \rightarrow n + p + \pi^+ + \pi^-$. The ratio found for the integrated cross sections $\sigma(n + p \rightarrow n + p + \pi^0)/\sigma(n + p \rightarrow p + p + \pi^-) = 2.67 \pm 0.43$ is shown to resolve a long-standing conflict with charge independence. The energy-dependence of the $n + p \rightarrow p + p + \pi^-$ cross section was inferred from the expected shape of the incident neutron spectrum with the aid of earlier cross section measurements in the energy range. The laboratory kinetic energy distributions and center-of-mass angular distributions for protons from $pp\pi^-$ events suggest that the peripheral mechanism of interaction is important at lower energies and to a greater extent than indicated by the one-pion-exchange model. However the Treiman-Yang test for this model is satisfied for events involving small momentum transfer and (3.3) isobar production. The cross section for the reaction $n + p \rightarrow n + p + \pi^+ + \pi^-$ increases more quickly above threshold than required by the statistical model of Cerulus and Hagedorn, and much more so than required by one-pion-exchange processes. Comparison with p-p scattering results, in which double-pion production is far smaller, emphasizes the importance of the T = 0 channel. (auth)

42404 DECAY MODE $K \rightarrow 2\pi + \gamma$. S. V. Pepper and Y. Ueda (Univ. of Rochester, N. Y.). Nuovo Cimento (10), 33: 1614-32(Sept. 16, 1964).

The radiative decay $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$ is considered in the light of the $\Delta T = \frac{1}{2}$ rule. The possibility that the nonradiative and radiative rates are of the same order of magnitude is investigated by constructing mechanisms that obey the $\Delta T = \frac{1}{2}$ rule in the absence of electromagnetic interactions. A boson pole model and a model involving a two-particle intermediate state are considered, and it is found that the former model can give contributions to the radiative rate that are of the same order of magnitude as the internal bremsstrahlung contribution. The pole model also furnishes an estimate of the rate for $K_{20} \rightarrow \pi^+ + \pi^- + \gamma$. (auth)

42405 A GENERALIZATION OF THE STUECKELBERG FORMALISM OF VECTOR MESON FIELDS. Y. Fujii (Tokyo Univ.) and S. Kamefuchi. Nuovo Cimento (10), 33: 1639-56(Sept. 16, 1964).

The Stueckelberg formalism of vector meson fields is generalized in such a way that the vector and scalar field variables, A_μ and B, have unequal masses. Such a generalization corresponds to the formulation of vector fields recently proposed by Feldman and Matthews. The quantization of the theory in the standard way of quantum field theory leads to the difficulties familiar in quantum electrodynamics. It is shown that the application of the Gupta-Bleuler method removes such difficulties. Some problems related to the indefinite metric are discussed in detail. (auth)

42406 REMARKS ON ω-φ AND OCTET-OCTET MIXING. H. D. Doebner and G. C. Hegerfeldt (Philipps-Universität, Marburg, Ger.). Nuovo Cimento (10), 33: 1724-7(Sept. 16, 1964).

In the SU_3 classification of particles and resonances one runs into difficulties when dealing with the 9 known $J^P = 1^-$ mesons ω; φ; ρ; K^*, $\overline{K}^*$, consisting of two isotopic singlets, a triplet and two doublets. If there are no further 1^- mesons they have to be grouped into an SU_3 octet and one singlet, but for both possibilities of building the octet ω; ρ; K^*, $\overline{K}^*$ and φ; ρ; K^*, $\overline{K}^*$ the Gell-Mann–Okubo mass formula in lowest order of the standard SU_3-breaking interaction fails in its linear form and the idea to calculate mass splittings for mesons in m^2 rather than in m, which was successful for 0^- mesons, does not solve the problem either. To overcome this difficulty without giving up SU_3 and the standard breaking interaction H_I it was suggested to take as the eighth member of the octet and for the singlet superpositions of ω and φ, or to blow up the singlet to an octet, requiring the existence of two 1^- meson octets, which are mixed by H_I resulting in the known 1^- mesons, plus an I = 1 resonance ρ', tentatively identified with the B-resonance at 1220 Mev and an unobserved $I = \frac{1}{2}$ resonance $K^{*\prime}$, $\overline{K}^{*\prime}$ at 990 Mev. Consequences following from the assumption that the singlet and the octet or the first and second octet are degenerate in the limit of full symmetry with a common mass M_0, leading to 9 or 16 physical particles after mixing, are discussed. This model allows to lower the number of constants by one and gives relations between masses and mixing angles. It turns out that the degenerate ω-φ mixing is in good agreement with experiment, for octet-octet mixing the model leads to predictions of unobserved resonances and is less satisfactory. (auth)

42407 HIGH-ENERGY PROTON-PROTON AND PION-PROTON DIFFRACTION SCATTERING. R. C. Kumar (Case Inst. of Tech., Cleveland). Nuovo Cimento (10), 33: 1728-31(Sept. 16, 1964).

It is shown that the experimental results of Foley et al. on the small angle p-p and $\pi^\pm$-p elastic scattering at energies > 10 Bev can be interpreted in terms of a Gaussian form of purely absorptive potential with the same range in the two cases. (auth)

42408 A MODIFIED CALCULATION OF THE $J = \frac{1}{2}$, $T = \frac{1}{2}$ π-N PHASE-SHIFTS USING KHURI REPRESENTATION. Rabi Majumdar (Univ. of Delhi). Nuovo Cimento (10), 33: 1734-5(Sept. 16, 1964).

A modification of the Khuri-Udgaonkar treatment of the $J = \frac{1}{2}$, $T = \frac{1}{2}$ π-N phase shifts is discussed. The contribution of the nucleon pole in the u-channel is explicitly isolated, and the rest of the amplitude is treated as Khuri and Udgaonkar. (C.E.S.)

42409 MODEL FOR THE 959 Mev δ-MESON. S. Rai Choudhury (Univ. of Delhi) and Lalit Kumar Pande. Nuovo Cimento (10), 33: 1736-9(Sept. 16, 1964).

The marked enhancement noted in the five-pion mass spectrum from the reaction $K^- + p \rightarrow \Lambda^0 + 2\pi^+ + \pi^0 + 2\pi^-$ is discussed. The distribution of the four $\pi^+\pi^0\pi^-$ combinations was found to show a peak at the η mass (550 Mev); it is therefore concluded that the new meson decays into $\eta + \pi^+ + \pi^-$. The remaining two-pion distribution seems to get enhanced around 360 Mev, which is very close to the mass of the s-wave di-pion resonance σ. This immediately suggests that the five-pion resonance, the meson (δ), could perhaps be explained in dynamical terms in a simple model of the scattering process $\eta + \sigma \rightarrow \eta + \sigma$, and this model is investigated. (C.E.S.)

42410 NEGATIVE MUON STAR PRODUCTION IN NUCLEAR EMULSION. D. Kotelchuck (Vanderbilt Univ., Nashville). Nuovo Cimento (10), 34: 27-39(Oct. 1, 1964).

Negative muon star production in nuclear emulsion is studied, with particular reference to its use in determining pion contamination in beams with $\pi/\mu \lesssim 10^{-3}$. Of 9.3×10^4 muon endings examined, (1.95 ± 0.07)% gave visible stars. The existence of muon stars having ≥3 prongs is ascertained, and the fraction of endings giving such stars is found to be $(5.8 \pm 1.2) \times 10^{-4}$. The results are compared and found in agreement with a simple model of muon capture through the weak interaction with a subsequent nuclear excitation energy of about (15 to 20) Mev. Evidence for capture near the nuclear surface is found. The results lead to a multiprong star detection efficiency for muons relative to pions of (1.7 ± 0.4) × 10^{-3}, which combined with exploitation of the range difference of the two kinds of particles permits contamination measurements much simpler than those performed by counters, and yet just as accurate. (auth)

42411 ON SPINOR CONNECTION IN A RIEMANNIAN SPACE AND THE MASSES OF ELEMENTARY PARTICLES. M. Sachs (Boston Univ.). Nuovo Cimento (10), 34: 81-92 (Oct. 1, 1964).

The transformation properties under time reversal of fundamental quaternion fields and the spin-affine connection in a Riemannian space are shown to lead to an eigenfunction equation whose eigenvalues can be identified with the masses of spinor particles. A one-to-one correspondence is established between the (coordinate-dependent) eigenvalues of this equation and a contraction of quaternion and spin-affine connection fields. The identification with the constant mass of a spinor particle follows only after the coupled nonlinear spinor field equations uncouple, in the asymptotic limit in which the interactions between particles can be assumed to be vanishingly small. In this limit, a generally covariant form of the "free-particle" Dirac equation emerges. A necessary part of the derivation is the demonstration of gauge invariance in the generally covariant spinor field equations. (auth)

42412 TWO-PION-EXCHANGE MODEL FOR $\pi + \mathcal{N} \rightarrow \mathcal{N}^* + \pi$ AND THE SECOND $\pi - \mathcal{N}$ RESONANCE. K. Itabashi (Argonne National Lab., Ill.). Nuovo Cimento (10), 34: 93-100(Oct. 1, 1964).

For the lower-energy $\pi + \mathcal{N} \rightarrow \mathcal{N}^* + \pi$ reaction, it is shown that the exchange of two-pion system (or the system of even G parity) with isotopic spin 2 and angular momentum 0 might become important. It is also shown that, if this is actually the case, then the reaction occurs predominantly from the $T = 1/2$, $d_{3/2}$ state of the initial $\pi\mathcal{N}$ system. Therefore, in connection with the problem of the second $\pi\mathcal{N}$ resonance, *the above possibility is interesting. Some possible* experimental tests of this possibility are suggested. (auth)

42413 *AN EXTREME-RELATIVISTIC REPRESENTA*TION FOR KEMMER PARTICLES. P. M. Mathews and A. Sankaranarayanan (Univ. of Madras). Nuovo Cimento (10), 34: 101-5(Oct. 1, 1964).

An extreme-relativistic representation is obtained for spin 0 and 1 particles described by the Kemmer equation. Observables characteristic of these particles in this representation are derived. (auth)

42414 POLARIZATION OF BREMSSTRAHLUNG RADIATION EMITTED IN THE HIGH-ENERGY COLLISION OF POLARIZED ELECTRONS WITH PROTONS. S. Sarkar (Indian Assn. for the Cultivation of Science, Calcutta). Nuovo Cimento (10), 34: 141-9(Oct. 1, 1964).

The purpose of this paper is to calculate the differential cross section and the circular polarization of the bremsstrahlung emitted in the high-energy collision of polarized electrons with protons taking into account the effect of the anomalous magnetic moment, the recoil momentum, and the two form factors of the proton. Further, the possibility of the proton emitting bremsstrahlung is also incorporated. When the incident electrons are polarized, bremsstrahlung of both circular and transverse polarizations occurs; if, however, the electrons are unpolarized, only transverse polarization is produced, *the estimate of which is available* from this analysis. (auth)

42415 ON DOUBLE AND TRIPLE PHOTOPRODUCTION OF PIONS. M. S. K. Razmi (London Univ.). Nuovo Cimento (10), 34: 150-62(Oct. 1, 1964).

The one-pion-exchange model of pion photoproduction from protons is considered at high energy. To eliminate the unknown $\gamma\pi$ interaction, the double and triple photoproduction processes are considered simultaneously in a restricted region of the phase space. The appropriately defined ratios of their differential cross sections represent the ratios of the $\mathcal{N}^*$ "production" to that of $\mathcal{N}$. These ratios are computed for several incident photon energies. (auth)

42416 EFFECT OF A PHENOMENOLOGICAL S-WAVE PION-PION INTERACTION ON THE PHOTOPRODUCTION *OF A PION PAIR IN A COULOMB FIELD.* G. Segrè (CERN, Geneva). Nuovo Cimento (10), 34: 215-20(Oct. 1, 1964).

The photoproduction of a pair of pions in the Coulomb field of a nucleus is studied. It is shown to be very sensitive to the effect of a final-state S-wave pion-pion interaction. Using various models for such an interaction, the double differential cross section for producing a pion pair in a Coulomb field is calculated and shown to be comparable to the nuclear field production for small momentum transfers. (auth)

42417 TOTAL CROSS-SECTIONS IN PERTURBATION THEORY IN THE HIGH-ENERGY LIMIT. P. Cazzola (Università, Padua). Nuovo Cimento (10), 34: 221-35 (Oct. 1, 1964).

Feynman's method for integration on internal momenta in Feynman amplitudes with the use of auxiliary variables is extended, so as to perform the integration on the final external momenta in the expressions for total cross sections. After integration on the final momenta, covariant integral representations are obtained for total cross sections, *in which the integrands exhibit a simple energy-dependence*, while the variable limits are completely independent of kinematics. It is argued that such expressions may be suitable to extract the dominant parts of total cross sections in the high-energy limit. In this connection, *two simple examples are given. (auth)*

42418 USE OF DEUTERON AS A TARGET OF FREE NUCLEONS. E. Pauli (Centre d'Etudes Nucleaires, Saclay, France), A. Muller, R. Barloutaud, J. Meyer, M. Beneventano, G. Gialanella, and L. Paoluzi. Nuovo Cimento (10), 34: 236-40(Oct. 1, 1964). (In French)

The reaction $\pi^+ + d \rightarrow \pi^+ + n + p$ is studied in a deuterium bubble chamber at π^+ kinetic energies of 600 to 850 Mev. Only events in which the slower ("spectator") nucleon emerging from the interaction has a momentum less than 180 Mev/c are retained. The interactions studied thus correspond to quasi-elastic scattering of π^+ mesons by protons (neutrons), with a neutron (proton) as a spectator. For spectator nucleon momenta below 180 Mev/c, the spectator-nucleon wave function approximates the Fourier transform of the deuteron wave function. The results show that, using the restrictions imposed in this experiment, it is possible to consider the neutrons in the target deuterons as "free" neutrons, and to measure angular distributions of particles scattered by these "free" neutrons. (T.F.H.)

42419 EXCITATION OF NUCLEON ISOBARS IN NUCLEON-NUCLEON COLLISIONS. A. B. Clegg (Oxford Univ.). Nuovo Cimento (10), 34: 244-7(Oct. 1, 1964).

It is hypothesized that the excitation of the 1510 and 1690 Mev nucleon isobars in nucleon-nucleon interactions may be produced by a peripheral one-pion-exchange mechanism of the type responsible for the 1238-Mev resonance. The two higher-energy isobars are able, in the model used, to be excited at quite large momentum transfers, as a result of large angular-momentum transfers involved in these resonances. (T.F.H.)

42420 ONE-PARTICLE-EXCHANGE FORCES AND MESON SUPERMULTIPLETS IN AN SU_3-INVARIANT MODEL. Hong-mo Chan, K. Dietz, and C. Wilkin (CERN, Geneva). Nuovo Cimento (10), 34: 250-6(Oct. 1, 1964).

An attempt is made, within the framework of plausible dynamic assumptions, to explain the spectrum of mesonic resonances up to the two-baryon production threshold. The model used is constructed to be SU_3-invariant. (T.F.H.)

42421 THE VECTOR MESONS AND THE GROUP Sp(6). G. Costa (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (10), 34: 257-60 (Oct. 1, 1964).

The Gell-Mann–Nishijima formula is modified as follows: $Q = I_3 + Y/2 + (B - Z)/2$, where Q is the electric charge quantum number, I_3 is the isospin number, Y is the hypercharge number, B is the baryon number, and Z is a number that is zero for the usual particles and can be ±1/3 for the so-called "trions." Two of the submultiplets of the SU_3 group having $Z = 0$ are contained in the same irreducible representation of the symplectic group Sp(6). The possibility of classifying the nine vector mesons within this representation is investigated. (T.F.H.)

42422 IMPROVED TIGHT BINDING APPROXIMATION FOR ELECTRONS IN PERIODIC FIELDS. E. Corinaldesi (Istituto Nazionale di Fisica Nucleare, Pisa, Italy). Phys. Letters, 12: 103-4(Sept. 15, 1964).

Non-orthogonality difficulties affecting the tight-binding perturbation calculation of the energy levels of electrons in periodic fields are overcome, by using a type of Modified-Schroedinger-Equation treatment. (T.F.H.)

42423 POSITRON SPECTRUM IN THE $K^+ \rightarrow e^+ + \pi^0 + \nu$ DECAY. G. Borreani, G. Rinaudo, and A. E. Werbrouck (Istituto Nazionale di Fisica Nucleare, Turin and Università, Turin). Phys. Letters, 12: 123-6(Sept. 15, 1964).

It is found that the positron spectrum in K_{e3}^+ decay is consistent with vector coupling (and constant or slowly varying form factor), or scalar coupling (and rather sharp dependence of form factor on pion energy). Tensor coupling is excluded. Assuming vector coupling, the properties of the hadronic current are studied. (T.F.H.)

42424 CONFIRMATION OF THE EXISTENCE OF THE Ω^- HYPERON. V. E. Barnes, P. L. Connolly, D. J. Crennell, et al. (Brookhaven National Lab., Upton, N. Y.). Phys. Letters, 12: 134-6(Sept. 15, 1964).

An analysis of about 2×10^6 ft of K^- meson tracks in a hydrogen bubble chamber (K^- momentum = 5.0 Bev/c) reveals an event that is interpreted as the production of an Ω^- hyperon, and its subsequent decay into a Λ^0 hyperon and a K^- meson. (T.F.H.)

42425 POSSIBILITY OF LARGE CP AND T VIOLATION IN WEAK INTERACTIONS. N. Cabibbo (CERN, Geneva). Phys. Letters, 12: 137-9(Sept. 15, 1964).

The possibility is discussed of a large violation of CP symmetry within the limits of the V–A theory of weak interactions, as completed by assumptions of definite SU_3 behavior of weak currents and of the non-leptonic Lagrangian. The scheme gives precise indications of experiments by which relatively large T violation effects could be found. Strict validity of the CPT theorem is assumed. (T.F.H.)

42426 ASYMPTOTIC RELATIONS BETWEEN AMPLITUDES OF THE PROCESSES WITH A VARIABLE NUMBER OF PARTICLES. A. A. Logunov, Nguyen Van Hieu, and I. T. Todorov (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 12: 139-41(Sept. 15, 1964).

For the interactions $\pi + N \rightarrow \pi' + \pi'' + N'$ and $\overline{\pi} + N' \rightarrow \overline{\pi'} + \overline{\pi''} + N$, the asymptotic amplitudes and differential cross sections are derived. N or N′ stands for p or n, and π, π', and π'' stand for discrete pions. (T.F.H.)

42427 NONLEPTONIC BARYON DECAYS AND EIGHTFOLD WAY. J. D. Bjorken and B. Hellesen (Institut for Teoretisk Fysik, Copenhagen). Phys. Letters, 12: 141-2 (Sept. 15, 1964).

The nonleptonic decays of baryons are examined in the framework of the eightfold way, with the assumption that the dominant mechanism is the mixing of baryon fields by the weak interaction. Experimental and theoretical decay parameters are found to be in agreement. (T.F.H.)

42428 PROPERTIES OF THE A_1 STUDIED IN 16 Gev/c π^- INTERACTIONS ON NUCLEI. J. F. Allard (Ecole Polytechnique, Paris), D. Drijard, J. Hennessy, et al. Phys. Letters, 12: 143-6(Sept. 15, 1964).

Production of the A_1 (mass 1.08 ± 0.02 Bev, full width 0.15 Bev) resonance in the $\pi\rho$ state is observed in low-momentum-transfer interactions of 16-Bev/c π^- mesons with C, F, or Cl nuclei. The reaction in question is $\pi^- + N \rightarrow \pi^+\pi^-\pi^- + N$. Analysis rejects 0^- and favors 1^+ or 2^- as the spin-parity of the A_1. (T.F.H.)

42429 CP INVARIANCE AND THE 2π DECAY MODE OF THE K_2^0. J. Bernstein, N. Cabibbo, and T. D. Lee (CERN, Geneva). Phys. Letters, 12: 146-8(Sept. 15, 1964).

It is postulated that the decay $K_2^0 \rightarrow 2\pi$ does not necessarily require violation of CP invariance. As an alternative, it is postulated that there exists a new long-range, extremely weak field that can be neglected so long as one does not deal with energies on the order of those measured in the two-pion decay of K_2^0 (namely, about 10^{-8} ev). It is assumed that this field produces a potential energy that is equal in magnitude and opposite in sign for K^0 and $\overline{K}^0$. The postulated interaction is CP-conserving. It is shown that this field could account for the two-pion decay of K_2^0. (T.F.H.)

42430 SOME REMARKS ON THE HIGHER πN RESONANCES. G. Hoehler and J. Giesecke (Technische Hochschule, Karlsruhe, Ger.). Phys. Letters, 12: 149-50 (Sept. 15, 1964).

The forward cross sections and forward amplitudes for charge exchange interactions between nucleons and pions are determined at pion energies of 1 to 6 Bev. Resonances are found in this interaction, with masses from 1.92 to 3.08 Bev. Experimental amplitude and cross-section values are compared with values calculated from the dispersion relations. (T.F.H.)

42431 A REMARK ON THE PAPER "PARTIAL WAVE SINGULARITIES NEAR $j = 1$ AND HIGH ENERGY ELASTIC SCATTERING." V. N. Gribov (Ioffe Inst. of Physics and Tech., Leningrad), I. Ya. Pomeranchuk, and K. A. Ter-Martirosyan. Phys. Letters, 12: 153(Sept. 15, 1964).

It is noted that the reggeon production amplitude in the vicinity of corresponding reggeonic thresholds probably fluctuates. The effects of this fluctuation on branching points in the complex j-plane, and on asymptotic elastic scattering amplitudes, are discussed. (T.F.H.)

42432 BARYON RESONANCES IN THE 10* SU_3 MULTIPLET. H. J. Lipkin (Argonne National Lab., Ill.). Phys. Letters, 12: 154(Sept. 15, 1964).

Photoproduction and decay selection rules that can be used for identifying members of the "10*" multiplet, and for studying the breaking of SU_3 symmetry, are pointed out. (T.F.H.)

42433 APPARENT CP VIOLATION DUE TO A NEW VECTOR BOSON. M. Levy and M. Nauenberg (CERN, Geneva). Phys. Letters, 12: 155-6(Sept. 15, 1964).

It is proposed that the 2π decay of the K_2^0 meson can be explained by the introduction of a neutral boson of very small mass, without invoking violation of CP symmetry. The properties of the light boson are as follows: its mass is less than the mass difference between K_2^0 and K_1^0; it is a vector particle, coupled to the strangeness current only, in a manner that preserves all strong selection rules (including strangeness and isotopic spin conservation); and it has isotopic spin 0 and strangeness 0. (T.F.H.)

42434 REMARKS ON CLASSIFICATIONS OF HADRONS ACCORDING TO SPIN AND INTERNAL SYMMETRIES. H. Bacry and J. Nuyts (CERN, Geneva). Phys. Letters, 12: 156-9(Sept. 15, 1964).

A method is presented for studying the connection between the Poincaré group and the internal symmetry groups, for the case in which the internal symmetry groups are restricted to the baryonic gage group. The problem is limited to a "compact little group," and completely solved for groups of rank two. The masses of the hadrons are supposed different from zero. (T.F.H.)

42435 ON THE CONSISTENCY OF $Z_3 = 0$ AND $\delta m^2 = 0$. P. Olesen (Universitetets Institut for Teoretisk Fysik, Copenhagen). Phys. Letter, 12: 159-60(Sept. 15, 1964).

The wave-function renormalization constant Z_3 and the self-mass δm^2 that appear in the Zachariasen (Phys. Rev., 121: 1851(1961)) model in field theory are considered. Conditions are investigated under which the values $Z_3 = 0$ and $\delta m^2 = 0$ are consistent and inconsistent. (T.F.H.)

42436 PARITY AND SIGN OF THE $\Sigma^+ \rightarrow n + \pi^+$ DECAY AMPLITUDE AND A MODEL FOR π^+ EMISSION IN HYPERNUCLEAR DECAYS. Frank von Hippel (Univ. of Chicago). Phys. Rev., 136: B455-71(Oct. 26, 1964).

It is found that the π^+/π^- emission ratio of 0.029 ± 0.01 in ${}_{\Lambda}He^4$ can be understood as due to the combined mechanisms: decay of a virtual Σ^+ hypernuclear state and the charge exchange of a π^0 from neutral Λ decay. Improvements upon simple perturbation-calculational techniques give $\pi^+/\pi^- \approx 0.015$ in near agreement with experiment, however, only if the decay $\Sigma^+ \rightarrow n + \pi^+$ is assumed to go to a final relative S state of the π^+ and neutron. Best agreement with experiment, for a D/F ratio of about 3 in the unitary symmetric strong pseudoscalar couplings, is obtained if the relative phases of the weak-decay amplitudes are determined according to unitary symmetry arguments. The observed low energy of the emitted π^+ mesons relative to the π^- mesons and the relative π^+ decay rates of different hypernuclei are qualitatively understood as primarily due to Pauli suppression effects in the final state. Reasons are given which suggest that the mesonic corrections to impulse-approximation calculations of the π^- and π^0 emission rates for the light hypernuclei will be small. (auth)

42437 THEOREM ON SEPARATION OF VARIABLES WITH APPLICATION TO STATIC-SOURCE MESON THEORY. Edward A. Remler (Univ. of North Carolina, Chapel Hill). Phys. Rev., 136: B491-5(Oct. 26, 1964).

A general formulation is given of the process by means of which one eliminates certain redundant degrees of freedom occurring in interacting quantum-mechanical systems. This may be considered a generalization of the transformation to center of mass in problems having translational invariance. When applied to the pion-nucleon system, the static-source approximation arises as the first term in a series, the higher terms of which are easily calculable using an algorithm. This system is not an expansion in the inverse mass of the nucleon, and it is shown that the static source approximation need not be considered as a nonrelativistic approximation. (auth)

42438 ANALYTICITY PROPERTIES OF HELICITY AMPLITUDES AND CONSTRUCTION OF KINEMATICAL SINGULARITY-FREE AMPLITUDES FOR ANY SPIN. Yasuo Hara (California Inst. of Tech., Pasadena). Phys. Rev., 136: B507-14(Oct. 26, 1964).

The analyticity properties of helicity amplitudes for binary reactions of particles with arbitrary spins are studied using the three properties: the analyticity properties of scattering amplitudes, assuming these are correctly predicted by perturbation theory; the crossing relations of helicity amplitudes near $s = 0$; and the threshold behavior of partial-wave amplitudes. Making use of these properties, kinematical singularity-free amplitudes for any spin are constructed by modifying helicity amplitudes. MacDowell reciprocity is generalized to arbitrary spin. Helicity amplitudes are proved to satisfy the Froissart limit at the high-energy limit. (auth)

42439 EFFECT OF UNSTABLE PARTICLE PRODUCTION ON SCATTERING AMPLITUDES. James S. Ball (Univ. of California, Los Angeles) and Peter Thurnauer. Phys. Rev., 136: B529-36(Oct. 26, 1964).

The model for pion-nucleon scattering proposed by Ball, Frazer, and Nauenberg is solved numerically. This model yields unitary scattering amplitudes while including the effects of ρ-meson production and the associated anomalous thresholds. The behavior of the solutions as a function of the width of the ρ meson and the pion-nucleon coupling constant is investigated. Cusps as well as broad peaks are generated in the elastic-scattering amplitude by the ρ-meson production. The effects of the complex singularities are investigated in detail by comparison with another treatment of pion-nucleon scattering in which anomalous cuts are absent. Also, the existence of poles on unphysical sheets is studied by means of a simplified model. (auth)

42440 POLARIZATION OF RECOIL PROTONS IN $\pi^{\pm}p$ ELASTIC SCATTERING NEAR 600 Mev. Richard D. Eandi, Thomas J. Devlin, Robert W. Kenney, Paul G. McManigal, and Burton J. Moyer (Univ. of California, Berkeley). Phys. Rev., 136: B536-42(Oct. 26, 1964). (UCRL-10629(Rev.))

Angular distributions of recoil-proton polarization in elastic $\pi^{\pm}p$ scattering were measured at 523-, 572-, and 689-Mev incident pion kinetic energy. Polarization measurements were made by observing the azimuthal asymmetry in the subsequent scattering of recoil protons in large carbon-plate spark chambers. Typical strong variation of the polarization with pion scattering angle near the πp diffraction minima was observed. Since existing opinion favors a D_{13} resonance at 600 Mev, a phase-shift analysis was attempted in order to confirm the existence and parity of this resonance. Available πp total and differential cross sections, these polarization data, and some possible restrictive assumptions related to the 600-Mev resonance were used in the analysis. Though the polarization results aided significantly in restricting the number of acceptable phase-shift sets, still, many plausible and qualitatively different sets were found. (auth)

42441 NEUTRAL MESON PRODUCTION WITH POLARIZED X RAYS. Darrell J. Drickey and Robert F. Mozley (Stanford Univ., Calif.). Phys. Rev., 136: B543-57 (Oct. 26, 1964).

Measurements of π^0 photoproduction were made at 235, 285, 335, and 435 Mev, using a beam of polarized x rays. Using a calculated value of polarization, an analysis is made which indicates a possible need for γ,ρ,π, or γ,ω,π coupling. The polarization calculations are checked by measurements made as a function of photon production angle at 335 Mev. (auth)

42442 SIMPLE THEOREM ON HERMITIAN MATRICES AND AN APPLICATION TO THE POLARIZATION OF VECTOR PARTICLES. Daniel Zwanziger (CEN, Saclay, France). Phys. Rev., 136: B558-62(Oct. 26, 1964).

It is proven that a necessary and sufficient condition for an n-dimensional Hermitian matrix ρ to be positive definite is that it be expressible in the form $\rho = OEO\dagger$, where O is a complex orthogonal matrix and E is a diagonal matrix with positive elements. This accomplishes a parametrization since O has $n^2 - n$ real parameters and E has n of them. The proof is constructive, giving O and E. It is further shown that the limit forms of this expression yield all the non-negative definite matrices. The parametrization for the polarization matrix of a spin-one particle is given explicitly. (auth)

42443 POLARIZED POSITRON ANNIHILATION IN FERROMAGNETS. Stephan Berko and Joel Zuckerman (Brandeis Univ., Waltham, Mass.). Phys. Rev. Letters, 13: 339a-41a(Sept. 14, 1964).

The angular correlations of the two photons emitted during positron annihilation in Fe and Ni are measured, using a parallel-slit system with good statistics. The measurements are made with the Fe and Ni samples magnetized to saturation both parallel and antiparallel to the positron momentum vector. The results are interpreted in terms of models for the electronic structure of Fe and Ni. (T.F.H.)

42444 TWO-PION STRUCTURE WITHIN THE A MESON. Richard L. Lander, Maris Abolins, D. D. Carmony, T. Hendricks, Nguyen-huu Xuong, and Philip M. Yager (Univ. of California, San Diego, La Jolla). Phys. Rev. Letters, 13: 346a-8a(Sept. 14, 1964).

A study is made of the $(\pi^+\pi^+\pi^-)$ correlations in the interaction $\pi^+ + p \rightarrow \pi^+ + p + \pi^+ + \pi^-$ at an incident pion momentum of 3.5 Bev/c. The A^+ meson is detected in these interactions, and is resolved into two peaks, denoted A_1 and A_2. The distributions show evidence against the spin-parity assignments of 1^- and 2^+ for A_1, and against 0^- and 1^+ for A_2. (T.F.H.)

42445 QUANTUM NUMBERS AND DECAY MODES OF THE $\eta 2\pi$ MESON. George R. Kalbfleisch, Orin I. Dahl, and Alan Rittenberg (Univ. of California, Berkeley). Phys. Rev. Letters, 13: 349a-53a(Sept. 14, 1964). (UCRL-11585)

Data are presented on the $\eta 2\pi$ meson. This meson is found to decay via all-neutral, $\pi^+\pi^-\eta$, and $\pi^+\pi^-\gamma$ modes. Its most probable quantum numbers are $TJ^{PG} = 00^{-+}$. The analysis are carried out by studying the resonances in the reactions $K^- + p \rightarrow \Lambda + n\,(\pi^+ + \pi^-) + \ldots$ at K^- momenta of 2.45 to 2.70 Bev/c, where $n \geq 0$. (T.F.H.)

42446 SEARCH FOR FRACTIONALLY CHARGED PARTICLES PRODUCED BY 27.5-Gev/c PROTONS. W. Blum, S. Brandt, V. T. Cocconi, et al. (CERN, Geneva). Phys. Rev. Letters, 13: 353a-5a(Sept. 14, 1964).

An investigation is carried out of the products from the interactions of 27.5-Bev/c protons with nuclear nucleons, in an attempt to detect product particles having electric charges of e/3 and 2e/3. It is concluded that long-lived particles having charges between 0.2 and 0.7 e are produced in these interactions with a cross section less than 10^{-35} cm^2 if the mass of the fractionally charged particles is less than or equal to 2.5 Bev, and with a cross section less than 10^{-32} cm^2 if the mass of the particles is less than or equal to 4.0 Bev. (T.F.H.)

42447 NEUTRAL STRANGE-PARTICLE PRODUCTION AND $Y_1^*(1385)$ FORMATION IN p-p COLLISION AT 5.5 Gev/c. G. Alexander, O. Benary, N. Kidron, A. Shapira, R. Yaari, and G. Yekutieli (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev. Letters, 13: 355a-8a (Sept. 14, 1964).

The production of neutral strange particles and the Y_1^* (1385) resonance in a sample of 25,725 proton–proton interactions at 5.52 Bev/c is analyzed, using a hydrogen bubble chamber. It is concluded that: the dominant process for Λ production is the $Y_1^*(1385)$ resonance; the formation of $Y_0^*(1405)$ via the neutral (i.e., $\Sigma^0\pi^0$) decay mode is of minor significance; in events of the type $pp \rightarrow \Sigma^0(\Lambda)NK$, where either the Σ^0 or the Λ does not belong to a Y_1^*, the $N-\pi^0$ pair is associated with the formation of the $N^*_{3/2}(1235)$ resonance; and the formation of mesonic resonances is negligible. (T.F.H.)

42448 POSSIBILITY OF CP VIOLATION IN $\Delta I = 3/2$ DECAY OF THE K^0 MESON. Tran N. Truong (Columbia Univ., New York). Phys. Rev. Letters, 13: 358a-61a (Sept. 14, 1964).

It is suggested that in the strangeness-changing decay of the K meson in which $\Delta I = 1/2$, CP is conserved, while in the decay in which $\Delta I = 3/2$, CP is violated. Theoretical and possible experimental consequences of this hypothesis are examined. (T.F.H.)

42449 CORRELATION OF POSITRON LIFETIME WITH THE ANGLE BETWEEN THE ANNIHILATION GAMMA RAYS. John D. McGervey and Virginia F. Walters (Western Reserve Univ., Cleveland). Phys. Rev. Letters, 13: 408-10(Sept. 28, 1964).

Positron lifetime distributions in Teflon were obtained for two different selections of angles between the annihilation gammas: small angles, which should include most of the singlet positronium annihilations, and large angles, which should include no singlet positronium annihilation. The results show that the long-lived component is less intense in the small-angle case than it is in the large-angle case. This is the expected result; it arises because the annihilations of singlet positronium, which has a short lifetime (1.25×10^{-10} sec), are included in the small-angle curve but not in the large-angle curve. (C.E.S.)

42450 MASS FORMULAS IN THE SU(6) SYMMETRY SCHEME. T. K. Kuo and Tsu Yao (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 13: 415-17 (Sept. 28, 1964).

It is proposed that the SU(6) symmetry is broken analogously as in SU(3), namely the primary symmetry-breaking term in the hamiltonian transforms like the I = 0, Y = 0, J = 0 member of the $\underline{35}$ representation. The major result of this assumption is that in a given SU(6) representation, states with the same I, Y, and J belonging to different SU(3) multiplets are mixed in a definite way. (C.E.S.)

42451 SPLITTING OF SPIN-UNITARY SPIN SUPERMULTIPLETS. Mirza A. Baqi Bég and Virendra Singh (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. Letters, 13: 418-21(Sept. 28, 1964).

Results that emerged in a systematic study of the problems associated with SU(6) classifications are presented. All mass formulas that can be derived by considering tensor operators transforming according to real representations of dimensionality less than 1000, which can contribute to the meson, baryon, and low-lying resonance spectra are considered. (C.E.S.)

42452 PROPERTIES OF THE 960-Mev BOSON. P. M. Dauber, W. E. Slater, L. T. Smith, D. H. Stork, and H. K. Ticho (Univ. of California, Los Angeles). Phys. Rev. Letters, 13: 449-54(Oct. 5, 1964).

The boson X^0 was observed in exposure of a hydrogen bubble chamber to meson (K^-) beams of 1.80 and 1.95 Bev/c. The data indicate a mass of 957 Mev and a width of <4 Mev with a 90% confidence limit. Evidence for $G = +1$ and $T = 0$ was noted, as well as for several possible spin-parity assignments. (D.C.W.)

42453 s-WAVE $\pi\pi$ INTERACTION AND $K_1^0K_2^0$ MASS DIFFERENCE. Sharashchandra H. Patil (Univ. of California, San Diego, La Jolla). Phys. Rev. Letters, 13: 454-7 (Oct. 5, 1964).

The $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$ decay via a single-pion intermediate state was studied. The k-π coupling was calculated for several models of s-wave, π-π interaction. The contribution of p-wave, π-π interaction in the form of the meson (ρ) was also calculated and found to be negligible. Within the framework of the models considered, the $K_1^0-K_2^0$ mass difference cannot be explained in terms of π,η poles, as suggested elsewhere. (D.C.W.)

42454 CONCISE RANGE MEASUREMENTS OF ALPHA PARTICLES BY ABSORPTION METHOD. Itsuhachiro Hataye and Kunihiko Hasegawa (Shizuoka Univ., Japan). Rept. Liberal Arts Sci. Faculty Shizuoka Univ., Nat. Sci., 3: 144-6(1962).

A Lauritsen type electroscope was used for range measurements of alpha particles by the absorption method. A graph of absorption curve, I/I_0 (I_0 is the original activity) versus absorber thickness D, obtained for a ^{210}Po source is shown. Assuming the following relationship of the energy of the incident particles to the slope of the absorption curve, $E_0 = K[(d\log(I/I_0))/(dD)]^{-n}$, an empirical formula was derived from the values of energy and the slope of the curve for ^{210}Po. The energy of alpha particles from an unknown source can be determined by comparing its scope of the absorption curve with that of ^{210}Po. (M.C.G.)

42455 ASYMPTOTIC BEHAVIOUR OF $\pi-\pi$ SCATTERING AMPLITUDE AND SINGULARITIES IN COMPLEX L-PLANE IN STRIP APPROXIMATION. Chang-chie Tsao (Peking Univ.). Wu Li Hsueh Pao, 20: 596-606(July 1964). (In Chinese)

The contribution of inelastic intermediate states to the singularities in complex l-plane and to the asymptotic behavior of crossed channel are investigated in the strip approximation. The procedure is to solve the simultaneous equations suggested by Chew, Frautschi, and Mandelstam by by means of the iteration method. The general iteration expressions for the s channel high energy amplitude f(s,t) and the t channel partial wave amplitude $f_l(t)$ are derived. It is shown that the divergence difficulty mentioned by Chew, Frautschi, and Mandelstam is not present in the iteration results of the f(s,t). The main results of first iteration are as follows: The total cross section falls slowly for not very high energies, but at the end tends to a constant. The diffraction angular distribution will have a long tail. As the energy increases, this long tail extends toward the small angle region. In the t channel a cut will appear along the real axis in complex l-plane; the right ending point of the cut is at $l = 1$ when $t = 0$, and moves to the left as t decreases, with a speed nearly half that of the vacuum pole. Higher order iterations are also investigated; the results are qualitatively analogous to those of first order. (auth)

42456 DEFINITION OF ANGULAR MOMENTUM EIGENFUNCTIONS IN VECTOR MESON THEORY. G. Meyer-Pundt and P. Sauer (Universität, Freiburg i. B.). Z. Physik, 180: 272-85(1964). (In German)

There are three possibilities for the introduction of angular momentum eigenfunctions in the vector-meson theory: multipole fields, orbital angular momentum eigenfunctions, and helicity eigenfunctions. These functions are defined by eigenvalue equations, and their mutual relation is shown. In analogy to the usual momentum quantization, the field can be quantized with respect to each of the three systems of angular momentum eigenfunctions. (auth)

42457 IS THE NUCLEON A BOUND STATE? Josef Rothleitner and Berthold Stech (Universität, Heidelberg). Z. Physik, 180: 375-84(1964).

A criterion is developed by which it can be experimentally determined whether the nucleon is a bound state of the N-π system. (D.C.W.)

42458 A RELATIVISTIC CALCULATION OF THE DEUTERON ELECTROMAGNETIC FORM FACTOR. Franz Lucretius Gross. Thesis, Princeton, N. J., Princeton Univ., 1963. 182p.

A relativistic calculation of the deuteron electromagnetic form factor, based on dispersion theory and generalized unitarity, is presented. The absorptive parts of the form factors are determined from the anomalous contributions of three diagrams: (1) the nucleon triangle, (2) the nucleon triangle with a pion exchanged across one of the deuteron vertices, and (3) the nucleon triangle with a pion exchanged across each of the deuteron vertices. The calculation is compared at every stage with non-relativistic potential theory, and after the two theories are cast into a similar form a very close correspondence between them emerges. The relativistic theory clarifies our understanding of potential theory and provides a relativistic determination of the deuteron wave functions. Potential theory gives a physical interpretation of the condition that must be imposed on the relativistic calculation in order that it be meaningful. This condition is that the G invariant in the deuteron-nucleon vertex be given by an unsubtracted dispersion relation, and this corresponds to the requirement that the D state wave function be normalizable. After this condition has been imposed, only one free parameter is left, corresponding non-relativistically to the normalization constant of the wave function. Adjusting this to give the correct deuteron charge gives the magnetic moment and quadrupole moment to within 10%. The energy dependence of the charge form factor does not agree well with experiment, but this seems to be only a reflection of the inadequacies of a one pion exchange approximation. (Dissertation Abstr., 25: No. 1, 1964)

42459 TWO-PION-EXCHANGE CONTRIBUTION TO THE THREE-BODY LAMBDA-NUCLEON INTERACTION.

Jeff D. Chalk, III. Thesis, Boulder, Colo., Univ. of Colorado, 1963. 168p.

The problem of deriving from quantum field theory an expression for the three-body interaction corresponding to the exchange of two pions between two nucleons and a lambda hyperon is treated. Two approaches are taken. In the first approach, a static model for the N-N-Λ system is defined so as to correspond to the nonrelativistic limit of pseudoscalar-pseudoscalar couplings; this model is used in conjunction with the Tamm-Dancoff method to derive the hypernuclear three-body potential to fourth order in coupling constants. The potential derived in the second approach, again to fourth order in coupling constants, is based on the covariant scattering-matrix formalism. It is found that the local part of the potential calculated by the latter method is very similar to that part of the static-model potential which corresponds to lambda-antisigma pair formation in an intermediate state. This potential is noncentral and has the form $(\vec{\tau}^1 \cdot \vec{\tau}^2)(\vec{\sigma}^1 \cdot \vec{x})(\vec{\sigma}^2 \cdot \vec{y})\, f(x,y)$, where $\vec{\tau}^j$ and $\vec{\sigma}^j$ ($j = 1,2$) are the isotopic and ordinary Pauli spin operators for the two nucleons, and $\vec{x}$ and $\vec{y}$ represent, respectively, the relative position vectors of nucleons 1 and 2 with respect to the lambda. The function $f(x,y)$ is highly singular ($f(x,y) \propto x^{-3}y^{-3}$) for small values of x and y. An estimate is made of the importance of this potential in the binding of the hypertriton by calculating its expectation value with respect to optimum ground-state wave functions, which correspond to hard core radii of 0.4 f and 0.6 f (1 f = 10^{-13} cm). In this way it is estimated that the contribution of three-body forces to the binding energy is less than 5 per cent relative to the contribution of lambda-nucleon two-body forces. (Dissertation Abstr., 25: No. 1, 1964)

42460 REGGE POLES AND THE GENERALIZATION OF THE POMERANCHUK THEOREMS TO THE PHOTOPRODUCTION OF PIONS. Robert Wayne Childers. Thesis, Nashville, Vanderbilt Univ., 1963. 165p.

The use of complex angular momentum in the quantum theory of potential interactions and in relativistic S-matrix theory is reviewed in Chapters II and III with emphasis on the relationship between a Regge trajectory and the dynamically possible bound states and resonances of a given physical system. In Chapter IV the photoproduction of pions is examined from the standpoint of the Regge pole hypothesis and the Mandelstam representation. The asymptotic behavior of the forward scattering amplitudes is determined in terms of the Regge trajectories of the $\gamma + \pi \rightarrow N + \bar{N}$ channel. The ρ, ϕ, and ω trajectories are included in the description of the photoproduction of neutral pions whereas only the ρ and π trajectories contribute to the photoproduction of charged pions. In the case of backward scattering, asymptotic representations of the scattering amplitudes are controlled by the trajectories of the $\gamma + N \rightarrow \pi + N$ channel by crossing. Finally, generalized Pomeranchuk relations are established for the differential cross sections in the forward and backward directions for the various charge configurations of the photoproduction channel. In particular the following results are obtained: (1) the differential cross sections for $\gamma + p \rightarrow n + \pi^+$ and $\gamma + n \rightarrow p + \pi^-$ are asymptotically equal in the forward and backward directions, (2) the differential cross sections for $\gamma + p \rightarrow p + \pi^0$ and $\gamma + n \rightarrow n + \pi^0$ are asymptotically equal in the backward direction. (Dissertation Abstr., 25: No. 1, 1964)

42461 THE METHOD OF COMPLEX ANGULAR MOMENTUM APPLIED TO THE MULTICHANNEL MODEL. George Hill Renninger. Thesis, Princeton, N. J., Princeton Univ., 1963. 109p.

The method of complex angular momentum is applied to the solutions of the equation of the multichannel model: $[(d^2)/(dx^2) - (\lambda^2 - 1/\alpha)/(x^2) + K^2]\,\phi = V\phi$, where V, ϕ, and K^2 are NxN matrices and $(K^2)_{ij} = k_j^2\,\delta_{ij}$, $k_j^2 = E - \epsilon_j$, ϵ_i is the positive excitation energy of the j^{th} channel. The properties of the solutions and the Jost matrices in the λ and E planes are examined with specific reference to their singularities. The Fredholm determinant is introduced in order to relate it, by means of the Fredholm theory, to the determinant of $f(\lambda, -K)$. It is shown that the Fredholm determinant does not possess any anomalous thresholds, even though $f(\lambda - K)$ may. The R-matrix is studied and a representation, similar to the usual one in the energy plane, is found in the $\beta = -\lambda^2$ plane. The possibility of a Sommerfeld-Watson transformation for the S-matrix is discussed. The poles of the S-matrix in the angular momentum plane are examined and the possibility of the factorization of the residue at a pole is considered. Using the Z-matrix, the behavior of a pole is studied when the energy varies in the vicinity of a channel threshold. (Dissertation Abstr., 25: No. 1, 1964)

42462 LOCALIZED STATES IN DE SITTER SPACE. Thomas Owen Philips. Thesis, Princeton, N. J., Princeton Univ., 1963. 147p.

Newton and Wigner have investigated the properties that characterize localized states of systems satisfying the transformation laws of special relativity. They suggest a number of natural invariance conditions which should be satisfied by states that could be called localized. An alternative set of localization postulates is proposed, which replaces one of the Newton-Wigner conditions by a Lorentz invariance condition. It is shown that in the 3 + 1 Minkowski space of special relativity these modified postulates define uniquely a set of localized states for spinless particles; the investigation has not yet been extended to particles with spin. The set of localized states is not the same as the Newton-Wigner set. In the 1 + 1 Minkowski space there seems to be no uniquely determined Lorentz invariant set of localized states. The work of Newton and Wigner suggests that it should be possible to define localized states by invariance conditions in other representations of elementary systems. In particular it has been proposed that this question be investigated for systems described by states in the hyperbolic de Sitter spaces. The discussion deals for mathematical simplicity primarily with the lowest dimensional de Sitter spaces. It is shown that in the spatially finite de Sitter space it is not possible to represent realizable physical systems, while in the infinite de Sitter space physical systems can apparently be obtained. In the infinite space localized states are found for spinless particles using sets of localization postulates analogous to the Newton-Wigner and the Lorentz invariant localization postulates of special relativity. (Dissertation Abstr., 25: No. 1, 1964)

42463 MYU-MEZON. (Mu Meson). A. O. Vaisenberg. Moscow, Publishing House "Science," 1964. 399p.

Data are given on the principal properties of μ mesons, π-μ-e decay, absorption of μ^- mesons by nuclei, electromagnetic interactions of μ mesons, mesomolecular effects, depolarization of μ mesons, and μ mesons in cosmic radiation. Extensive bibliographies are given for each chapter. (R.V.J.)

Field Theory and Quantum Mechanics

42464 (AD-433256) NON-RELATIVISTIC COLLISION THEORY. II. CLASSICAL AND QUANTUM CROSS SECTIONS. Edward Gerjuoy (Plesset (E. H.) Associates, Inc., Los Angeles). Oct. 1, 1961. Contract AF29(601)-4335. 109p. (TR-120)

Scattering rates, laboratory and cms cross sections, classical cross sections, momentum-transfer cross sections, many-particle scattering, interference, small-angle scattering multiple scattering, and laboratory and equivalent one-particle cross sections are discussed. Diffraction effects are included. The report is part II of a series beginning with AD-433257. (R.E.U.)

42465 (AD-433257) NON-RELATIVISTIC COLLISION THEORY. I. REVIEW OF CONVENTIONAL POTENTIAL SCATTERING THEORY ONE DIMENSIONAL PROBLEMS. Edward Gerjuoy (Plesset (E. H.) Associates, Inc., Los Angeles). July 1, 1961. Contract AF29(601)-4335. 139p. (TR-116)

Methods of treating problems in "conventional" potential scattering theory, which relates the cross section to the asymptotic form of the wave function at infinity, or equivalently, in three-dimensional problems, to the phase shifts of the various partial waves, are summarized for one-dimensional problems. (R.E.U.)

42466 (JINR-D-1735) SPACE, TIME, CAUSALITY IN MICROWORLD. D. I. Blokhintsev, Yu. A. Gol'fand, V. G. Kadyshevskii, D. A. Kirzhnits, and G. I. Kolerov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 89p.

In English and Russian.

Selected topics in quantum field theory and relativity theory are presented; included are causality in field theory, acausality and dispersion relations, homogeneity and isotropy of space, field theory in quantized space-time, discrete-time quantum mechanics, and field theory with nonlocal interaction. (R.E.U.)

42467 (JINR-E-1786) ELECTROMAGNETIC INTERACTIONS (EXPERIMENTAL). Norman Ramsey (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 15p. (CONF-550-65)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A review is presented of experimental confirmations of quantum electrodynamics, electron scattering experiments, pion photoproduction, and muons and mesic atoms. (R.E.U.)

42468 (JINR-E-1787) WEAK INTERACTIONS (THEORETICAL). S. B. Treiman (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 15p. (CONF-550-69)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A review is presented of papers on weak-interaction theory. The two-pion decay of K_2^0, which implies CP breakdown, is discussed. (R.E.U.)

42469 (JINR-E-1794) SYMMETRY OF STRONG INTERACTIONS (THEORETICAL). A. Salam (Joint Inst. for Nuclear Research, Dubna. U.S.S.R.). 1964. 40p. (CONF-550-74)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

A review is presented of papers on group-theoretic ideas in symmetry physics of strong interactions. Included are successes of unitary symmetry (SU_3), composite models of elementary particles based on triplet models, group extensions and super-symmetries such as $SU_3 \times SU_3$, and dynamic models. (R.E.U.)

42470 (JINR-P-1719) SKOROST PEREDACHI VOZBUZHDENIYA V KVANTOVOI ELEKTRODINAMIKE. (The Velocity of the Excitation Exchange in Quantum Electrodynamics). M. I. Shirokov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 26p.

The quantum electrodynamic problem of excitation exchange between two atoms is solved. The atoms are separated by the distance R. Initially, at $t = 0$ atom A is excited, atom B is not, and electromagnetic quanta are absent. The probability $w(t)$ is calculated that B at later moment, t, is excited. In contradiction with the theory of relativity, $w(t)$ is found to be nonvanishing in time interval (0 to R/c) assuming an appreciable value in the interval ($R/c - \lambda/c$ to $R/c + \lambda/c$) whose length is of the order of the period λ/c of the exchange photon. Such a result is the consequence of nonvanishing of the "causal" function out of the light cone. The project of the corresponding experiment is discussed. It appears, that if wave length λ of the exchange radiation is of the order of a meter, one can "prepare" initial state fairly quickly for being able to speak about the behavior of $w(t)$ in an interval of the length λ/c. The main experimental difficulty seems to consist in the smallness of the absolute values of $w(t)$ under these conditions. Old solutions of this problem are discussed as well as some possible theoretical objections concerning the calculations and the proposed experiment. (auth)

42471 (JINR-P-1736) UNITARNAYA SIMMETRIYA ELEMENTARNYKH CHASTITS. (Unitary Symmetry of Elementary Particles). Ya. A. Smorodinskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 44p.

A revised version of lectures on tensor algebra of SU(3) and its applications to elementary particle physics is given. The mass splitting is described using the multipole model of interaction. Some recent ideas are reviewed. (auth)

42472 (JINR-P-1762) FUNKTSIONALNYE INTEGRAL V KVANTOVOI ELEKTRODINAMIKE I INFRAKRASNAYA ASIMPTOTIKA FUNKTSII GRINA. (Functional Integrals in Quantum Electrodynamics and Infrared Asymptotics of Green Functions). B. M. Barbashov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 17p.

The Green's functions of the Klein-Gordon and Dirac equations are written down as functional integrals in an arbitrary external field. It is shown that the functional integrations are performed for the fields allowing the exact solution of the equations (the constant field and the field of the flat wave). The form of the solutions obtained provides the quantum Green's functions, and a study of their asymptotic behavior in the infrared region by using the method of functional averaging over the external field. Corrections to Bloch-Nordsick's formula were found for the simple model of field theory. (auth)

42473 (LAMS-3099) THEORY OF GRAVITATION, 1959–1963. Bibliography. Helen J. Chick, comp. (Los Alamos Scientific Lab., N. Mex.). June 1964. Contract W-7405-eng-36. 65p.

A listing of 515 titles is presented, alphabetically according to author. The bibliography supplements LAMS-2328 (1960). (R.E.U.)

42474 (MATT-274) MULTIPLE TIME SCALE APPROACH TO THE DERIVATION OF QUANTUM MECHANICAL KINETIC EQUATIONS. D. Book (Princeton Univ., N. J. Plasma Physics Lab.). June 1964. Contract AT(30-1)-1238. 114p.

Frieman's multiple time scale method is applied to the quantum mechanical B-B-G-K-Y hierarchy. In general there is a long time scale on which the one-particle distribution relaxes to equilibrium and at least one short time scale that measures the duration of two-particle encounters. For a weakly coupled gas, solutions of the hierarchy are systematically obtained in the first few orders of a perturbation expansion and used to derive the quantum mechanical analog of the Fokker-Planck equation, which is shown to be the Uehling-Uhlenbeck equation in the Born approximation. The expansion parameter ϵ is the ratio of average kinetic energy and the short time scale is shorter by ϵ^2 than the long scale. The Coulomb plasma is treated in several cases, including strongly degenerate and quasiclassical limits, and the appropriate kinetic equations are derived. Here the expansion parameter is the inverse of the number of particles in a Debye sphere. There is a short time scale corresponding to encounters at separations on each of the basic scale lengths: the distance of minimum approach, the de Broglie wave length, the interparticle separation, and the Debye shielding length. The quantum mechanical Boltzmann equation including exchange effects is obtained by extension of a method of Wyld and Fried. (auth)

42475 (NP-14326) ON A REGULARIZED MODEL OF QUANTUM ELECTRODYNAMICS (thesis). Hedzer Adam Ferwerda (Groningen, Netherlands. Rijksuniversiteit). 1964. 75p.

A regularized model of quantum mechanics was investigated in perturbation expansion. Regularization of the propagators and vertices eliminates ultraviolet divergences. (R.E.U.)

42476 LEVINSON'S THEOREM (AN ELEMENTARY DERIVATION). Marcel Wellner (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Am. J. Phys., 32: 787-9(Oct. 1964).

If a spherical potential admits n bound states with a certain angular momentum, then Levinson's theorem states that $\delta(O) - \delta(\infty) = n\pi$, where $\delta(E)$ is the scattering phase shift (corresponding to that angular momentum) as a function of energy. This is shown here by means of elementary wave mechanics. (auth)

42477 STATISTICAL MECHANICS OF A QUANTUM SYSTEM OF HARD LINES. Douglas Henderson (Arizona State Univ., Tempe). Am. J. Phys., 32: 795-8(Oct. 1964).

The energy levels of a one-dimensional quantum system of hard lines are obtained exactly, and the resulting thermodynamic properties are evaluated by means of the grand partition function. No phase transitions occur. At high temperatures the thermodynamic properties of this system reduce to the well-known results for a classical system of hard lines. (auth)

42478 COMPARISON THEOREMS FOR CONVERGENCE OF REGULARIZED FIELD THEORIES. William M. Frank (Naval Ordnance Lab., Silver Spring, Md.). Ann. Phys. (N. Y.), 29: 175-216(Sept. 1964).

The convergence of a sufficiently regularized field theory—one in which the bare propagators for the boson and fermion fields with Yukawa coupling are everywhere finite—is considered. Theorems are proved allowing the comparison of spinor fermion theories with scalar-type fermion theories in which the propagator is the unit matrix in spin space and of scalar fermion theories with each other. The convergence of pseudoscalar meson theory is reduced to that of scalar meson theory. The application to other than vacuum S-matrix elements is briefly outlined, and the theorems are applied to some models. (D.C.W.)

42479 ANALYTIC PROPERTIES OF THE VACUUM TO VACUUM S-MATRIX IN REGULARIZED FIELD THEORIES. William M. Frank (Naval Ordnance Lab., Silver Spring, Md.). Ann. Phys. (N. Y.), 29: 217-31(Sept. 1964).

The methods of the preceding paper are applied to regularized field theories to determine the analytic properties in $z(= \frac{1}{2}g^2$, g is the coupling constant) and η of the vacuum amplitudes $\mathscr{S}_V(z, \eta)$ and $\overset{\circ}{\mathscr{S}}_V(z, \eta)$ which, respectively, include and exclude the process of pair creation and annihilation at a point. It is found that there is a sequence of closely spaced poles in η which merge into a branch cut in the limit $V \to \infty$. This cut is along a segment of the real axis for scalar fermion theories and is a complex curve for spinor fermion theories. For values of η other than on the cut, $\mathscr{S}_V(z, \eta)$ and $\overset{\circ}{\mathscr{S}}_V(z, \eta)$ are entire functions of z, having exponential orders, respectively, not exceeding $\frac{2}{3}$ and 1. For the PS(PS) theory both amplitudes have exponential order not exceeding $\frac{2}{3}$. (auth)

42480 THE TWO-BODY PROBLEM IN GEOMETRODYNAMICS. Susan G. Hahn (International Business Machines Corp., New York) and Richard W. Lindquist. Ann. Phys. (N. Y.), 29: 304-31(Sept. 1964).

The problem of two interacting masses is investigated within the framework of geometrodynamics. It is assumed that the space-time continuum is free of all real sources of mass or charge; particles are identified with multiply connected regions of empty space. Particular attention is focused on an asymptotically flat space containing a "handle" or "wormhole." When the two "mouths" of the wormhole are well separated, they seem to appear as two centers of gravitational attraction of equal mass. To simplify the problem, it is assumed that the metric is invariant under rotations about the axis of symmetry, and symmetric with respect to the time t = 0 of maximum separation of the two mouths. Analytic initial value data for this case were obtained by Misner; these contain two arbitrary parameters, which are uniquely determined when the mass of the two mouths and their initial separation have been specified. A particular case is treated in which the ratio of mass to initial separation is approximately one-half. To determine a unique solution of the remaining (dynamic) field equations, the coordinate conditions $g_{0\alpha} = -\delta_{0\alpha}$ are imposed. The set of second order equations is then transformed into a quasi-linear first-order system, and the difference scheme of Friedrichs is used to obtain a numerical solution. Its behavior agrees qualitatively with that of the one-body problem and can be interpreted as a mutual attraction and pinching-off of the two mouths of the wormhole. (auth)

42481 QUANTIZATION OF THE PENTADIMENSIONAL LINEARIZED FIELD. Philippe Droz-Vincent. Cahiers Phys., 18: 25-37(Jan. 1964). (In French)

The commutation relations of the unitary field in the theory of Y. Thiry are calculated. The study is limited to the linear approximation so that Fourier transforms can be used to establish commutation relations compatible with the field equations. The Heaviside unit system $c = \hbar = 1$ is adopted. The results are immediately comparable to those that can be obtained separately for the gravitational and electromagnetic fields. (J.S.R.)

42482 PROPAGATORS AND QUANTIZATION IN GENERAL RELATIVITY. André Lichnerowicz. Cahiers Phys., 18: 83-92(Feb. 1964). (In French)

The concept of the propagator and some of its applications are investigated in a study limited to free fields. The mathematical theory of propagators is outlined, and the commutators of the free electromagnetic field and the nonuniform gravitational field are derived. Spinor fields are also discussed, and creation-annihilation operators are considered. (J.S.R.)

42483 HEAT CONDUCTANCE OF FERMI GAS IN A QUANTIZING MAGNETIC FIELD. P. S. Zyryanov (Inst. of Physics of Metals, Academy of Sciences, USSR). Fiz. Metal. i Metalloved., 18: 161-3(1964). (In Russian)

Formulas were developed for Nernst coefficients and thermal conductivity in a quantizing magnetic field. It is shown that the Wideman-Francis law holds for the quantum and classical cases. Thermoelectrodynamic forces and thermal conductivity oscillations were examined. The obtained data are in agreement with data offered by M. Steel et al. (Phys. Rev., 98: 358(1955)). (tr-auth)

42484 ON LINEARISATION OF THE RELATIVISTIC HAMILTONIAN. K. C. Kar (Inst. of Theoretical Physics, Calcutta). Indian J. Theoret. Phys., 6: 65-7(June 1958).

It is shown that the relativistic hamiltonian for a free electron in an assembly is a vector and so can be linearized directly without introducing unnecessary complications of Dirac matrices. (auth)

42485 NOTE ON THE LINEARISATION OF THE RELATIVISTIC HAMILTONIAN. K. C. Kar (Inst. of Theoretical Physics, Calcutta). Indian J. Theoret. Phys., 6: 107-9(Dec. 1958).

The relativistic hamiltonian was linearized by a perfectly logical wavestatistical method without introducing Dirac matrices. (auth)

42486 LINEAR RELATIVISTIC HAMILTONIAN AND THE ELECTROMAGNETIC FIELD. K. C. Kar and Sabita Purkayastha (Inst. of Theoretical Physics, Calcutta). Indian J. Theoret. Phys., 7: 25-31(June 1959).

The direct method and the method of taking the wave-statistical average, for the linearization of the relativistic hamiltonian, without matrices were critically discussed. It is shown that the relativistic hamiltonian is a world vector in the space-time continuum. The linear hamiltonian without matrices for a charged particle in the electromagnetic field was also studied. It is shown that the well-known term involving H representing the energy of a magnetic dipole comes out on recombining the two linear hamiltonian in the electromagnetic field. (auth)

42487 ON THE RELATIVITY OF UNIFORM ROTATION. Anadi J. Das (Calcutta Univ.). Indian J. Theoret. Phys., 7: 33-40(June 1959).

The meaning of uniform rotation is properly analyzed and clarified in the light of the principle of relativity. It is shown that uniform rotation is not an absolute motion and there exists a special relativity of uniform rotation. (auth)

42488 NOTE ON DIRAC METHOD OF LINEARISING THE RELATIVISTIC HAMILTONIAN. K. C. Kar (Inst. of Theoret. Phys., Calcutta). Indian J. Theoret. Phys., 7: 53-5(Sept.-Dec. 1959).

It is pointed out that conditions for linearizing the relativistic hamiltonian by the Dirac method are ignored in its subsequent use. It is also shown that all the Dirac results can be obtained if unit vectors are introduced instead of unnecessarily complicated matrices. (auth)

42489 ON THE PERTURBATION THEORY WITH TIME-DEPENDENT WAVE FUNCTIONS. K. C. Kar (Inst. of Theoretical Physics, Calcutta). Indian J. Theoret. Phys., 7: 65-72(Sept.-Dec. 1959).

The well-known perturbation formula used in radiation problems was derived from an entirely wave statistical point of view. (auth)

42490 RADIATION OF CHARGED PARTICLES PENETRATING A METALLIC SCREEN. D. M. Sedrakyan (Inst. of Physics and Tech., Academy of Sciences, Armenian SSR). Izv. Akad. Nauk Arm. SSR, Ser. Fiz. Mat. Nauk, 27: 113-21(1964). (In Russian)

Radiation from charged particles penetrating an ideally conducting half-plane at a given distance from the edge was examined in order to characterize the radiation related to particle diffraction on a metallic screen. The Maxwell equations are resolved considering the limitations imposed by an ideally conducting metal screen. The electric and magnetic fields produced by the particle were found. (R.V.J.)

42491 VELOCITY MODULATION OF A RELATIVISTIC ELECTRON BEAM. P. C. T. DeBoer (Univ. of Maryland, College Park). J. Appl. Phys., 35: 2789-92(Oct. 1964).

Velocity modulation of a one-dimensional electron beam is treated relativistically, starting from the collisionless Boltzmann equation and using first-order perturbation theory. A general expression for the perturbation current density j_1 is applied first to a mono-energetic unperturbed beam. Compared to the nonrelativistic case, the magnitude of j_1 is reduced by the factor $(1 - u^2/c^2)^{3/4}$, where u is the unperturbed beam velocity and c the velocity of light. The distance between the maxima of j_1 is increased by the inverse of the same factor. Relativistic effects decrease the efficiency of modulation η, which is defined as the energy carried by the electric field generated by the perturbations divided by the energy flux in the unperturbed beam. For an unperturbed beam with a rectangular velocity distribution of narrow width w and a fixed mean velocity u_m, the results are independent of w to first order. Expressions for j_1 and η are also found for an unperturbed beam with a rectangular momentum distribution of arbitrary width. When this width is small and increasing as u_m is fixed, j_1 increases in second order if the beam is highly relativistic or if its plasma frequency is larger than the frequency of modulation, while it decreases otherwise. Under either condition η decreases in second order. (auth)

42492 INVARIANT IMBEDDING AND THE ASYMPTOTIC BEHAVIOR OF SOLUTIONS TO INITIAL VALUE PROBLEMS. G. Milton Wing (Sandia Corp., Albuquerque, N. Mex.). J. Math. Anal. Appl., 9: 85-98(Aug. 1964). (TID-18804)

The invariant imbedding method is applied to a problem of the type $L\mu(t) = f(t)\mu(t)$ in which L is a second order linear differential operator and the behavior of the fundamental solutions for large t is known. The asymptotic behavior of that solution satisfying the initial conditions $U(0) = C_1$ and $U'(0) = C_2$ is sought. (C.E.S.)

42493 THEORY OF FINITE SYSTEMS OF PARTICLES. I. THE GREEN FUNCTION. Clasine Van Winter. Kgl. Danske Videnskab. Selskab, Mat. Fys. Skrifer, 2: No. 8, 1-60(1964).

A study is made of the resolvent operator for a system consisting of any finite number of particles. It is assumed that all the forces in the system arise from square-integrable local two-body interactions. The resolvent is considered for complex energies not in the continuous spectrum of the Hamiltonian. It is represented by an integral operator, the kernel of which is called the Green function. In the energy plane cut along the positive real axis, the Green function G^2 for a system of two particles is obtained from an integral equation. Owing to the assumption on the interaction, this equation has a Hilbert-Schmidt kernel. As a result it can be solved by the Fredholm method. With G^2 as a supposedly known quantity, an integral equation for G^3 is constructed, which again has a Hilbert-Schmidt kernel, and hence is again soluble. Next the procedure is extended to successively larger systems. For n particles, an integral equation is found from which the Green function G^n can be obtained once the functions $G^2, G^3, \ldots, G^{n-1}$ are known. By an induction argument an upper bound is derived for the Schmidt-norm of each successive kernel K^n. This is shown to be finite at every interior point of the energy plane cut along the continuous spectrum of the n-particle Hamiltonian H^n. In the cut plane the Fredholm expressions converge irrespective of the strength of the interaction. The Green function G^n is regular except for the cut and for possible poles on the negative real axis. These correspond to bound states, the eigenfunctions of H^n following directly from the residues of G^n. The method does not give information on the behavior of the Green function in the neighborhood of the continuous spectrum. (auth)

42494 SECOND-TYPE SINGULARITIES OF FEYNMAN GRAPHS. V. E. Asribekov (Scientific Information Inst., Moscow). Nucl. Phys., 56: 161-73(July 1964).

An analysis is made of second-type (non-Landau) singularities for arbitrary Feynman graphs. It is shown that the second-type singularities of Feynman graphs can, in the general case, be reduced to the conventional (Landau) singularities of the graphs reduced in the corresponding manner. A method is indicated of finding such reduced graphs from the initial Feynman graph. An elaborate study is made of the conditions of the appearance of second-type singularities for one- and two-loop graphs, and characteristic examples of such graphs are considered. Also conditions are studied for the second-type singularities in the case of the simplest three-loop graph ("triangle"). (auth)

42495 ANOMALOUS SPINOR EQUATIONS. Asher Peres (Israel Inst. of Tech., Haifa). Nucl. Phys., 59: 615-17(Nov. 1964).

Two-component anomalous spinor equations, describing particles of non-vanishing mass, are derived from a generally covariant Lagrangian principle. Some properties of the solutions are discussed, and some difficulties are pointed out. (auth)

42496 NONEQUILIBRIUM STATISTICAL MECHANICS BASED ON INFORMATION THEORY. A. Katz (Weizmann Inst. of Science, Rehovoth, Israel). Nuovo Cimento (10), 33: 1544-51(Sept. 16, 1964).

A general method for predicting averages of quantities at any time based on knowledge of other quantities at given times is set up. The method is based on the principle of maximizing the missing information subject to consistency with given information. The equations of motion are used to translate information from one time to another. The derivation of Pauli's master equation is treated as an example. (auth)

42497 THE APPROACH TO EQUILIBRIUM IN A CLOSED SYSTEM. A. Katz (Weizmann Inst. of Science, Rehovoth, Israel). Nuovo Cimento (10), 33: 1552-7 (Sept. 16, 1964).

A closed system never forgets and cannot ever reach equilibrium. However, the approach to equilibrium may still take place weakly, in the sense that for any operator there exists a time long enough so that its average approaches the equilibrium value, but for any time however long, quantities may be found that are far from equilibrium. The statement of the weak limit is formulated mathematically using the information-theory approach. It is seen that the statement of the weak limit is connected to the decay in time of correlations. (auth)

42498 A QUANTUM FIELD-THEORETICAL MODEL WITH GROUND STATE OF DECREASED SYMMETRY. G. Marx and G. Kuti (Roland Eötvös Univ., Budapest). Nuovo Cimento (10), 33: 1558-75(Sept. 16, 1964).

A self-coupled scalar field is discussed which has two ground states in the classical theory. The quantum-theoretical calculation uses the variational method proposed by Schiff. The ground state and the first excited states are calculated. Excitation energies and scattering amplitudes turn out to be finite after mass and charge renormalization. Two quantum-mechanical ground states are obtained, but they do not belong to the same Hilbert space. One can solve the eigenvalue problem using only one Hilbert space but in this case the ground state does not show all the symmetries possessed by the hamiltonian. (auth)

42499 PROPER TIME AND RIGIDITY IN ACCELERATED FRAMES OF REFERENCE. J. E. Romain (General Dynamics, Fort Worth, Tex.). Nuovo Cimento (10), 33: 1576-83(Sept. 16, 1964).

A criterion for rigidity of a noninertial frame of reference was previously introduced in the form of the postulate that the velocity of light in the noninertial frame is time-independent. It is proved that, if a one-dimensional noninertial frame satisfies this postulate, the following two requirements are equivalent: the coordinate time in the accelerated frame is equivalent to proper time; the accelerated frame satisfies Born's criterion for rigidity. Further investigation of the compatibility of the above-mentioned definition of rigidity and of Born's definition, in the case of a one-dimensional system, shows that these two definitions are compatible only in the case of hyperbolic motion. (auth)

42500 ELEMENTARY AND MACROSCOPIC FREE-SPINNING TEST-PARTICLE IN GENERAL RELATIVITY. S. Bonazzola (Università, Rome). Nuovo Cimento (10), 33: 1584-99(Sept. 16, 1964).

An attempt is made to establish the inner angular momentum evolution equations of the macroscopic and the elementary spinning test-particle in general relativity. By so doing it is possible to compare the behavior of an elementary particle with that of a macroscopic particle in general relativity. For that, it is necessary to define the inner angular momentum of a macroscopic particle, i.e., to chose a supplementary condition for the Papapetrou's equations. The physical meaning of the supplementary conditions proposed by Papapetrou, Pirani and Tulczyjew is discussed, and it is concluded that Tulczyjew's condition is the more suitable to define the inner angular momentum of a macroscopic particle. A classical interpretation of the evolution equations is given by introducing the standard dynamical quantities, relative to a prefixed frame of reference. (auth)

42501 FIELD OPERATORS AS C^∞ FUNCTIONS IN SPACELIKE DIRECTIONS. H. J. Borchers (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). Nuovo Cimento (10), 33: 1600-13(Sept. 16, 1964).

It is shown that it is only necessary to test the field operators in the timelike direction. The $\int A(x^0,x)f(x^0)dx^0$ exists as unbounded operator and is infinitely often differentiable in spacelike direction. (auth)

42502 A GENERALIZATION OF THE LANDAU GAUGE. Th. A. J. Maris, V. E. Herscovitz, and G. Jacob (Universidade do Rio Grande do Sul, Porto Alegre, Brazil). Nuovo Cimento (10), 33: 1633-8(Sept. 16, 1964).

A gage was derived in which the γp-part of the self-energy integral for the electron, with Γ_μ = constant $\cdot$ γ_μ but with arbitary photon and electron propagators, vanishes identically. For the special case of the free photon propagator this diagonalizing gage is the Landau gage. Using this generalized Landau gage the Dyson equation for the electron propagator, in which only the approximation Γ_μ = constant $\cdot$ γ_μ was made, reduces to an integral equation for one scalar function. (auth)

42503 THE ANGULAR DISTRIBUTION OF DELBRÜCK SCATTERING. J. C. Herrera and P. Roman (Boston Univ.). Nuovo Cimento (10), 33: 1657-66(Sept. 16, 1964).

The gage-invariant effective Lagrangian of Schwinger is quantized and is used to form a transition matrix which then permits the application of standard covariant calculational tools of quantum electrodynamics for the low-energy range of vacuum polarization phenomena. The new technique is applied to the calculation of the differential cross section, for arbitrary directions, of Delbrück scattering. The result is exact in the low-energy limit. (auth)

42504 A THREE-DIMENSIONAL WKB APPROXIMATION FOR THE DIRAC EQUATION. M. Rosen (Naval Research Lab., Washington, D. C.). Nuovo Cimento (10), 33: 1667-79(Sept. 16, 1964).

A three-dimensional semiclassical approximation is developed and used to describe the precession of the polarization of a Dirac particle in an electromagnetic field and the dynamical and kinematical origin of the precession clearly exhibited. The rate of change of the longitudinal polarization is calculated and shown to arise entirely from that change in orientation of the classical trajectory due to the influence of the electric field alone. The effect of the anomalous moment is exhibited by consideration of the Dirac equation modified by inclusion of a Pauli moment term. (auth)

42505 CAUSALITY AND CONFORMAL INVARIANCE. A. Gamba and G. Luzzatto (Università, Genoa). Nuovo Cimento (10), 33: 1732-3(Sept. 16, 1964).

The physical consequences of an important theorem of Zeeman are discussed. It is shown that the theorem rules out the possibility that Lorentz invariance can be generalized physically to a broader group, for example the conformal group. The price for such a generalization would be nothing less than causality. (C.E.S.)

42506 ON THE PROPERTIES OF LANDAU CURVES. T. Regge (Inst. for Advanced Study, Princeton, N. J.) and G. Barucchi. Nuovo Cimento (10), 34: 106-40(Oct. 1, 1964).

A derivation of several properties of Landau curves is carried out with the methods of algebraic geometry. In particular, formulas have been established for the characteristics of large classes of Landau curves. A determinantal formalism has been shown to be particularly useful in connection with the theory. (auth)

42507 STOCHASTIC SPACE-TIME. R. L. Ingraham (New Mexico State Univ., University Park). Nuovo Cimento (10), 34: 182-97(Oct. 1, 1964).

The basic theory of the space-time continuum considered as a 4-dimensional manifold of random variables for each Lorentz observer (co-ordinate frame) $\mathcal{S}$, is developed from first principles. No assumption about the actual coordinate measurement process is needed except that, whatever its details, it be describable in terms of random variable theory. The "fundamental length" λ, which gives a limit in principle to the fineness with which space-time points can be resolved, enters physical theory via the dispersion $\propto \lambda^2$ of the space-time random variable. The main content of the theory comes from the great restrictive power of a symmetry group. Examples of this power are the theorem that there exist no form-invariant (equivalently: mean fields and S operator independent of $\mathcal{S}$) stochastic space-times, and the theorem that if time is measured in terms of space with the aid of light signals (the Einsteinian prescription), the coordinate frequency function is uniquely fixed as a 3-dimensional Gaussian. (auth)

42508 S-MATRIX UNITARITY AND CURRENT OPERATOR IN QUANTUM FIELD THEORY. L. Streit (Universität, Hamburg). Nuovo Cimento (10), 34: 198-204(Oct. 1, 1964).

It is pointed out that the connection between the scattering matrix and the current operator on the mass shell leads to an elementary inequality for matrix elements of the latter. The derivation of this condition, which is carried out for a theory of spin-zero particles, uses only unitarity and translation invariance of the S-matrix. An application of the inequality to currents given as finite Wick expansions in terms of a free field shows that expansions of higher than second degree are inadmissible. This follows without assuming the existence of a local field operator. (auth)

42509 ON THE PROBLEM OF COMBINING THE INHOMOGENEOUS LORENTZ GROUP WITH A LIE GROUP. A. Beskow and U. Ottoson (Chalmers Tekniska Högskola, Goteborg). Nuovo Cimento (10), 34: 248-9(Oct. 1, 1964).

Physical interpretations of combinations of the strong-interaction symmetry group with the inhomogeneous Lorentz group are considered. If G is a Lie group having three infinitesimal operators, and if at least two of these operators are generators of "semisimple" groups, and if the operators have other specified properties, then G is a direct product of two of the subgroups generated by two of the infinitesimal operators. (T.F.H.)

42510 BROKEN SYMMETRIES, MASSLESS PARTICLES, AND GAUGE FIELDS. P. W. Higgs (Univ. of Edinburgh). Phys. Letters, 12: 132-3(Sept. 15, 1964).

The theorem that "Any solution of a Lorentz-invariant theory that violates an internal symmetry operation of that theory must contain a massless scalar particle" is considered. A proof that failure of this theorem in the nonrelativistic case cannot exist, when Lorentz invariance is imposed on a theory, is the point of discussion. It is shown that this proof itself fails for the class of field theories in which the conserved currents are coupled to gage fields. (T.F.H.)

42511 PERTURBATION THEORY OF TRANSVERSE TRANSPORT PROCESS IN STRONG MAGNETIC FIELD. Shi-kang Chen. Wu Li Hsueh Pao, 20: 579-95(July 1964). (In Chinese)

Certain questions of the transport process in strong magnetic field are discussed. It is shown that for this type of transport process one must consider the boundary condition explicitly. For transverse conductivity, it is not necessary to solve the kinetic equation of the Boltzmann type when the boundary condition is treated correctly, and Titeica's picture is shown to be correct in general order of perturbation expansion. Secondly, the solution of the case of external electric field $\omega \neq 0$ and its transition to the classical case are discussed. It is shown that under the same condition $\omega_H \tau > 1$, $E_0 \tau \gg 1$, the quantum solution is different from that of the classical case. The question of eliminated divergence produced by the integral of state density is discussed. It is indicated that in the realizable case a term of magnitude $(\epsilon_c/kT)^0$ is as important as that of $-\ln(\epsilon_c/kT)$. This correction makes the theoretical value of ρ_T/ρ_L consistent with the experimental data. (auth)

42512 NON-LINEAR SPINOR EQUATIONS AND REFINED RELATIONS. G. Braunss (Technische Hochschule, Darmstadt, Ger.). Z. Naturforsch., 19a: 825-7(July-Aug. 1964). (In German)

It is shown that the nonlinear term of the Heisenberg-Pauli equation can be interpreted as torsion of space-time. (D.C.W.)

42513 ON THE COMBINATORICS OF FEYNMAN GRAPHS. PART I. Klaus Helmers and Ta-chung Meng (Universität, Frankfurt am Main). Z. Physik, 180: 325-39 (1964).

As a preliminary step toward a rigorous proof of Dyson's conjectures on the combinatorics of Feynman graphs, the following lemma is proved: the generating functional of the time-ordered Green's functions in perturbation theory is an exponential, the exponent of which is a sum of contributions from connected graphs only, with no contributions from vacuum graphs. A scalar hermitean field $A(x)$ with an A^4 self-coupling is used as a model. (auth)

42514 INTRODUCTORY QUANTUM ELECTRODYNAMICS. E. A. Power. Mathematical Physics Series. London, Longmans, 1964. 155p. 24s.

A resume of quantum electrodynamics is presented. Topics covered specifically include: free fields; quantized free fields; assemblies of identical particles; Fock space; radiation fields in vacuo; Lagrangian and Hamiltonian for the coupled system of electromagnetic field and nonrelativistic sources; applications of perturbation theory to the interaction of the electromagnetic field with nonrelativistic charges; the interaction of the electromagnetic field with bound charges; and self-interactions. (T.F.H.)

42515 A SECOND-ORDER SECOND QUANTIZED SPINOR THEORY. James Gregory Broerman. Thesis, St. Louis, St. Louis Univ. 1963. 185p.

Feynman and Gell-Mann have proposed that all fermions with non-zero rest mass be described by a two-component spinor, satisfying a second order wave equation, as a method for explaining the "V−A" coupling in β decay. This theory was slightly modified by Brown, who showed that the second order theory is equivalent to the Dirac theory in first quantized electron theory. This paper attempts a generalization of the Brown theory to second quantized field theory. The method of Schwinger is used. A fully quantum mechanical Lagrangian is constructed by requirements of orthochronous Lorentz invariance and generalized gauge invariance. This Lagrangian yields the Klein-Gordon equation as a field equation. The constants of the motion and the anti-commutation relations are then constructed. The subsidiary condition of Brown can be imposed on an auxiliary spinor used in the Lagrangian, and with this condition it is shown that the theory is equivalent to the Dirac theory in the free field case. The theory is then generalized to electrodynamics and it is shown that the theory is formally identical to the Dirac theory and still maintains a two-component interpretation, with a second order field equation. Strong interactions between a fermion doublet and a pseudoscalar triplet are analyzed. It is shown that the theory cannot be made equivalent to the Dirac theory for this case and still maintain a two-component interpretation. The only interaction which is allowed is a pseudovector pion derivative interaction, and this is non-renormalizable. (Dissertation Abstr., 25: No. 1, 1964)

42516 LOWER BOUNDS TO THE EIGENVALUES OF HAMILTONIANS BY INTERMEDIATE PROBLEMS. Jackson Gilbert Gay. Thesis, Gainesville, Fla., Univ. of Florida, 1963. 79p.

Bazley and Fox have given procedures for determining lower bounds to eigenvalues, which are applicable to many quantum mechanical hamiltonians. Three of the procedures of Bazley and Fox are outlined and a new procedure also using the projection technique of Aronszajn and based on the method of intermediate problems is presented. One of the procedures of Bazley and Fox is applied to a system of two electrons confined by an isotropic harmonic well. The other two alone with the new procedure are used to obtain lower bounds to the ground state of the helium atom. The best lower bound for the helium ground state, −2.9095 (au), was obtained with the new procedure as the first eigenvalue of an intermediate problem of order six. This lower bound has approximately one-third the error of a lower bound obtained from a calculation based on the method of Stevenson and Crawford, which was of comparable difficulty and which gave a wave function of the same functional form. (Dissertation Abstr., 25: No. 1, 1964)

42517 CORRELATION ENERGY OF A MANY ELECTRON SYSTEM. Manjit Singh Bhatia. Thesis, Tallahassee, Fla., Florida State Univ., 1963. 82p.

The problem of the correlation energy of an electron gas at actual metallic densities is considered. For this purpose the collective theory of the electron interactions developed by Bohm and Pines is employed. The validity of the basic Bohm-Pines assumption, that the ground state of the extended system is identical to that of the actual physical system, in the high density limit for electron gas is examined. The Sawada-Wentzel Hamiltonian for the electron gas altered to include the auxiliary variables is used. It is found that the Bohm-Pines assumption is valid for the problem under consideration for q such that $-q^2 < k\,(m^2\hbar^2\omega_{pl}^2/p_f^2)$, $0 < k < 3$. Then the Bohm-Pines intermediate transformation is modified so that it minimizes the ground state energy at the intermediate stage. When the correlation energy at this stage is computed considerable improvement in energy over the corresponding Pines' result is found. Finally a perturbation theoretic unitary transformation is applied to our intermediate Hamiltonian so that the field-particle interaction is eliminated in the first order and then compute the correlation energy. The final result for correlation energy at typical metallic densities is approximately fifteen per cent lower than the results quoted by Nozieres and Pines. (Dissertation Abstr., 25: No. 1, 1964)

42518 CONTRIBUTIONS TO THE THEORY OF QUANTUM LIQUIDS. Fa-yueh Wu. Thesis, St. Louis, Washington Univ., 1963. 115p.

The ground state of a many-body system is studied by the use of the Jastrow wave function. As an example in treating the boson system, numerical calculations are carried out for liquid ^{4}He at absolute zero. With the aid of the Kirkwood superposition approximation and the empirical data on the density as well as the radial distribution function, the two-particle correlation factor of He II is computed and compared with the explicit approximation derived by Abe. The kinetic energy, estimated at 21.1°K/atom, and the measured total energy are used, in conjunction with the virial theorem, to determine the coefficients of a 6-n Lennard-Jones potential. An extremum principle is set up, which proves to be useful in the study of the boson system in general. In the study of the fermion system, the ground state wave function generated by a system of interacting bosons is used as the correlation factor in the trial wave function. Expectation values are then computed by the technique of cluster development for which a new procedure is proposed and rigorously established in all orders. The resulting cluster integrals are evaluated by introducing simple approximate forms for the n-particle distribution functions defined by the boson wave function. To illustrate the method, it is used to establish a connection between known results for fermion and boson forms of a hard sphere system at low density. As a second illustration experimental information on He II is used to work out properties of a hypothetical fermion type system of mass 4. Results are given for the energy, effective mass, and susceptibility. (Dissertation Abstr., 25: No. 1, 1964)

Geophysics

42519 (SUI-64-1) AN EXPERIMENTAL STUDY OF CHARGED PARTICLES IN THE OUTER RADIATION ZONE. L. A. Frank, J. A. Van Allen and H. K. Hills (Iowa. State Univ., Iowa City). Jan. 1964. 54p. (NASA-CR-53169; N64-17579)

Studies of the charged-particle fluxes near the magnetic equatorial plane in the vicinity of the outer radiation zone, based on five months of data from Explorer XIV, are presented. The spectra, fluxes, radial distributions, and temporal variations of the charged particles detected are discussed and presented graphically. Typical electron fluxes measured in the heart of the outer zone are given. The gross temporal variations of electron fluxes were by a factor of ~100, ~10, and ~100, respectively, for energy ranges of ≥40, ≥230 kev, and ≥1.6 Mev. A positive correlation between K_p daily sums and equatorial fluxes of electrons ($E \geq 40$ kev) is demonstrated. Slow inward radial motion of energetic ($E \geq 1.6$ Mev) electrons was observed after periods of geomagnetic activity. The effects of Soviet nuclear bursts of late October and early November 1962 on the natural radiation fluxes are discussed. At $L = 3.2$ near the equator, the flux of protons ($E \geq 500$ kev) was 7×10^6 (cm^{2}sec)$^{-1}$, and the flux of electrons ($E \geq 40$ kev) was 3×10^7 (cm^{2}sec)$^{-1}$, with no temporal variations within the experimental error of a factor of 2 or less. (auth)

42520 INFLUENCE OF SUNSPOT ACTIVITY ON THE GEOMAGNETIC ACTIVITY IN THE NORTHERN AND SOUTHERN SOLAR HEMISPHERES. Muammer Dizer (Kandilli Observatory, Istanbul). Ann. Geophys., 19: 72 (Jan.-Mar. 1963).

The intensity of terrestrial magnetic activity has a semi-annual variation, with maxima at the equinoxes and minima near the solstices. It has been suggested that the equinoxial maxima of geomagnetic activity are due to the approach towards the maximum sunspot zone of the earth's projection on the northern and southern hemispheres of the solar disk. Gleissberg, from calculation of the international magnetic character numbers for the earth heliographic latitudes $B_0 > +5°$ (July 23-Oct. 25) and $B_0 < -5°$ (Jan. 20-Apr. 22), concluded that the variation of the difference of magnetic activity between the two intervals, calculated for all solar cycles, was produced by the difference of the northern and southern sunspot activity. The present computations were of the mean sunspot area observed in the northern hemisphere of the sun from July 23 to Oct. 25 and in the southern hemisphere from Jan. 20 to Apr. 22, in a band 50° wide in heliographic longitude around the central meridian of the solar disk for all year. The difference between northern and southern mean sunspot area and the magnetic activity, calculated for two intervals, are respectively represented by ΔS and ΔC. If the difference of the magnetic activity between the earth heliographic latitudes $B_0 > +5°$ and $B_0 < -5°$ is to be explained by the difference between the northern and southern sunspot activity, then the sequence of ΔS should show the same variation as in the case of ΔC. However, the linear correlation coefficient between ΔS and ΔC is −0.094. Consequently, the difference between the northern and southern sunspot activity does not appear to be correlated with the geomagnetic activity. (BBB)

42521 I.G.Y. AURORAL VISOPLOTS. A Diagrammatic Presentation of Visual Auroral Data for the Period July 1957 to December 1958. B. McInnes, ed. Ann. Intern. Geophys. Yr., 29: 1-506(1964).

The results of visual auroral observations during the IGY are presented as auroral visoplots for the northern and southern hemisphere. (D.C.W.)

42522 CATALOGUE OF DATA IN THE WORLD DATA CENTERS FOR THE PERIOD OF THE INTERNATIONAL GEOPHYSICAL YEAR AND INTERNATIONAL GEOPHYSICAL COOPERATION—1959 (1 JULY 1957—31 DECEMBER 1959). Ann. Intern. Geophys. Yr., 36: 1-744(1964).

A guide to data obtained during the International Geophysical Year and International Geophysical Cooperation (1959) is presented, covering meteorology, geomagnetism, auroras, airglow, ionosphere, solar activity, cosmic radiation, longitudes and latitudes, glaciers, oceanography, rocket and satellite probes, seismology, gravimetry, and radioactivity levels. The nature and location of the observations are given, together with references for the results. (D.C.W.)

42523 THE ENERGY OF MAGNETIC STORMS. Sydney Chapman (High Altitude Observatory, Boulder, Colo.). Geophys. J., 8: 514-36(July 1964).

The extra magnetic energy present in the magnetosphere during a magnetic storm is shown to be the same as if the disturbing field existed without the main field of the Earth: that is, the "joint" energy of the two fields is zero. The disturbance field energy is considered for both the first and the main phase of a storm, on the basis of idealized models of the electric currents that cause the disturbance. The currents, actually distributed throughout volumes, are taken to flow only on surfaces. Numerical estimates of the field energy are given, for a weak storm and for a great storm. The magnetic moment of the field of the ring current is also considered; it is inferred that it is only a small fraction of the Earth's dipole moment. The field energy of magnetic storms is found to be less than the kinetic energy associated with the ring current at the peak of the main phase. (auth)

42524 SOLAR CONTROL OF THE ANNUAL VARIATION OF THE QUIET-DAY HORIZONTAL COMPONENT

OF GEOMAGNETIC FORCE. A. Yacob (Colaba Observatory, Bombay). Indian J. Meteorol. Geophys., 14: 81-6 (Jan. 1963).

The predominant component of the mean annual variation of Hq for Alibag for the period 1904 to 1958 is the 12-monthly component. For Huancayo, for the period 1923–1946 it is the 6-monthly component which is found to be predominant. This difference is accounted for by considering the annual variation of Hq as a consequence of the superposition of Sq on Hq. Huancayo being much closer to the geomagnetic as well as the geographic equators than Alibag, the variation in the course of a year of the intensity of the ionospheric Sq current circuits will largely be a semi-annual feature for Huancayo, while for Alibag this variation will largely be an annual feature. While the amplitudes of the 12-monthly components of individual years show very little correspondence with sunspot numbers, the amplitudes of the 6-monthly components show appreciable correspondence with sunspot numbers. To explain this feature the variation in the heliographic latitude of the earth, in the course of the year, coupled with the emanation of short-wave radiation of high ionization potential from solar active regions, which are known to form two average belts 10–15°N and S of the solar equator, is suggested in the preference to the incidence of disturbance on Hq, since the dates of maxima of the 6-monthly component for years of high sunspot numbers are found to be closer to the equinoxial months. (auth)

42525 NEUTRINO AND GEOTHERMAL FLUXES. John D. Isaacs and Hugh Bradner (Scripps Institution of Oceanography, La Jolla, Calif.). J. Geophys. Res., 69: 3883-7 (Sept. 15, 1964).

Heat generation in the earth's interior by neutrino interactions is considered. Estimates of the neutrino flux and interaction rates are compared with the generation of geothermal heat. It is concluded that neutrinos probably are not a significant source of geothermal heat, but experimental evidence does not rule out the possibility that neutrinos dominate heat generation in the earth. (D.C.W.)

42526 LENGTH OF MAGNETOSPHERIC TAIL. A. J. Dessler (Rice Univ., Houston, Tex.). J. Geophys. Res., 69: 3913-18(Oct. 1, 1964).

It is shown that hydromagnetic waves, through the action of radiation pressure, can prevent the tail of the magnetosphere from closing near the earth. It is argued that the tail of the magnetosphere may be 20 to 50 AU long. The tail can close at such heliocentric distances in the charge-exchange boundary shell where the solar wind is terminated and ion-atom collisions are relatively frequent. (auth)

42527 TRAPPED PARTICLES IN A DISTORTED DIPOLE FIELD. Donald H. Fairfield (Ames Research Center, Moffett Field, Calif.). J. Geophys. Res., 69: 3919-26 (Oct. 1, 1964).

A dipole magnetic field is analytically compressed and extended to represent a possible effect of the solar wind on the geomagnetic field on the day and night side of the earth in the earth-sun meridian plane. The first and second adiabatic invariants of particle motion are used to calculate the mirror points of constant energy particles in the compressed and extended fields. The results support and clarify work by previous investigators, showing that shifts in mirror points of particles moving from one field to the other are large at large distances and smaller at lower altitudes. The results are compared to the experimental findings of recent satellites. It is concluded that field distortion may be a major cause of the observed shift in mirror points, but that final resolution of the problem will depend on further determination of the magnetic field on the night side of the earth. (auth)

42528 SOLAR CYCLE CHANGES IN INNER-ZONE PROTONS. Robert C. Blanchard and Wilmot N. Hess (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 69: 3927-38(Oct. 1, 1964).

Calculations on time dependence of the inner Van Allen belt proton population show that large changes of the population up to a factor of 50 will take place during the solar cycle. The effect is most pronounced for the region of B-L space corresponding to minimum altitudes of 300–700 km. Because protons of different energies respond to the changing solar cycle at different rates, the proton energy spectra will change with time also. (auth)

42529 THE EFFECTS OF ATMOSPHERIC COLLISIONS ON GEOMAGNETICALLY TRAPPED ELECTRONS. Martin Walt (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Res., 69: 3947-58(Oct. 1, 1964).

The time dependence of the flux of geomagnetically trapped electrons resulting from the July 9, 1962, high altitude nuclear explosion was calculated assuming that the only forces perturbing the trapped electrons were collisions with atmospheric constituents. These theoretical results are compared with experimental data obtained with satellites. At L = 1.185 and L = 1.25, where L is McIlwain's magnetic shell parameter, there is good agreement between theory and experiment. At higher L values, however, the observed time changes were more rapid than those predicted by the atmospheric scattering theory. It is concluded that during the latter part of 1962 and the early part of 1963 the chief mechanism for removing electrons trapped in the region $L \lesssim 1.25$ was atmospheric scattering. Processes other than atmospheric scattering governed the loss of electrons trapped on magnetic shells $L \gtrsim 1.25$. (auth)

42530 A SUPPOSED DEPENDENCE OF GEOMAGNETIC STORMINESS ON LUNAR PHASE. T. W. Davidson and D. F. Martyn (Commonwealth Scientific and Industrial Research Organization, Camden, Australia). J. Geophys. Res., 69: 3973-9(Oct. 1, 1964).

The geomagnetic daily planetary indices from 1932 to 1961, and also the starting days of great magnetic storms from 1840 to 1954, are examined for possible dependence on lunar phase. It is concluded, in agreement with Bartels but contrary to the findings of Bigg, that there is no evidence of any such dependence. (auth)

42531 SYNCHROTRON RADIATION FROM AURORAL ELECTRONS. Glen L. Hower (Washington State Univ., Pullman) and Allen M. Peterson. J. Geophys. Res., 69: 3995-4001(Oct. 1, 1964).

The techniques previously used to calculate the synchrotron radiation from an artificial belt of trapped particles are applied to the case of radiation from particles spiraling about the magnetic field lines over the auroral zone. The results are presented in terms of various combinations of particle energies and intensities that would provide an observable signal in the upper h-f to lower v-h-f band. Although the required intensities are considerably higher than the intensities normally present according to available satellite measurements, it is concluded that the mechanism does offer a possible explanation for some of the previous observations of auroral noise during very severe disturbances. (auth)

42532 ARTIFICIALLY INJECTED ELECTRONS AT LOW ALTITUDES. J. D. Mihalov, F. S. Mozer, and

R. Stephen White (Aerospace Corp., El Segundo, Calif.). J. Geophys. Res., 69: 4003-13(Oct. 1, 1964).

Results are reported from experiments carried out in October and November 1962 on satellites 1962$\beta\epsilon$ and 1962βo. The data were obtained at 240 to 450 km above the South Atlantic where the geomagnetic field is weak. The fluxes and energy distributions of electrons injected by high-altitude nuclear explosions are presented. During November 6 through 11, 1962, the maximum omnidirectional flux measured from the Starfish injection was 1.4×10^6 fission electrons cm^{-2} sec^{-1} at B = 0.225 gauss, L = 1.50. At the same time the maximum omnidirectional flux measured from Soviet injections in October and November was 1.8×10^6 fission electrons cm^{-2} sec^{-1} at B = 0.243 gauss, L = 1.77. The October flux at L = 2.1 was increased by more than a factor of 100 in November after the Soviet explosions. The lower limit to the mean lifetime measured at these altitudes for Starfish electron fluxes at $2.1 < L < 1.7$ was 17 days. The mean lifetime of the Soviet electron fluxes near B = 0.252 gauss, L = 1.77 was 7 days. Electron energy distributions at L = 1.50 and L = 1.77 were fission-like. Electron energy spectra at higher L values were softer. (auth)

42533 ON THE LOCATION OF THE EFFECTIVE EQUATOR FOR THE F REGION OF THE IONOSPHERE. Agodi Onwumechilli (Univ. of Ibadan, Nigeria). J. Geophys. Res., 69: 4015-20(Oct. 1, 1964).

A method capable of precisely defining the position of the effective equator is outlined. The method is applied to the analysis of the noon values of f_0F_2 and post sunset h′F peak during the equinoctial months, March and September 1958. It is found that in the latitude zone of 40 to 70° only the dipole latitude has significant control on f_0F_2, whereas in the equatorial zone only the dip equator controls f_0F_2 significantly. The data analyzed showed minimum f_0F_2 at the dip equator in the African and American sectors; lack of southern stations in the Asian sector makes a definite statement about this region difficult. The analysis of the postsunset h′F peak reveals a dual control of equal weight by the dip equator and the dipole equator. The effective equator for this parameter and anomaly is therefore halfway between the dipole and the dip equators and is termed the mean magnetic equator. The h′F data analyzed showed a maximum at the mean magnetic equator in all sectors of the earth. (auth)

42534 A 10-KILOCYCLE PER SECOND DOPPLER OBSERVATION OF THE INTERMEDIATE LAYER OF THE NIGHTTIME IONOSPHERE. D. G. Cartwright (Commonwealth Scientific and Industrial Research Organization, Camden, Australia). J. Geophys. Res., 69: 4031-5(Oct. 1, 1964).

An electron density profile of the nighttime ionsophere was obtained by rocket observation of the Doppler shift of 10.2-kc signals transmitted from the ground. The experiment showed a layer between the usual E and F regions. Suggestions are made about future experiments of this kind. (auth)

42535 IONOSPHERIC INVESTIGATIONS BY THE FARADAY ROTATION OF INCOHERENT BACKSCATTER. G. H. Millman (General Electric Co., Syracuse, N. Y.), V. C. Pineo, and D. P. Hynek. J. Geophys. Res., 69: 4051-65(Oct. 1, 1964).

Radar measurements of ionospheric incoherent backscatter performed during January and February 1961 at the U. S. Air Force Trinidad test site, West Indies, with a high-powered pulsed radar operating at a frequency of 425 Mc are described. Transmissions made with linear polarization showed evidence of ionospheric Faraday rotation. During the daytime, approximately 450° polarization rotation was observed when the antenna beam was oriented toward Bogota, Colombia. Theoretical calculations of the magnitude of the Faraday effect, evaluated from vertical incidence ionsopheric soundings recorded at Trinidad and Bogota, correlated to a high degree with the experimental data. The electron density profile deduced from incoherent backscatter-angular rotation data is in close agreement with the distribution determined from the power measurement. The height and the ionization density of the peak of the F layer measured in the direction of Bogota are both greater than those measured at vertical incidence and in the direction of Puerto Rico. (auth)

42536 EFFECTIVE RECOMBINATION COEFFICIENT IN THE E REGION. A. P. Mitra (Pennsylvania State Univ., University Park). J. Geophys. Res., 69: 4067-79(Oct. 1, 1964).

On the assumption that the ion production rate at E-layer maximum varies diurnally with the cosine of the solar zenith angle, a relative value of an instantaneous recombination coefficient can be derived which changes only slightly with the time of day. These changes are attributed to the effect of vertical ion drift due to the S_q current system. Consequently, the absolute value of the true recombination coefficient can be derived with the conventional comparison method at the (appropriately redefined) focus of the S_q current system. An estimate of the drift perturbations of the coefficient can be obtained by using the proportionality between the drift gradient and the magnetic north component (X′) of the S_q variations in the horizontal magnetic field on the ground. The relatively small diurnal variations found for the value of the instantaneous recombination coefficient in contrast with the large diurnal variation obtained by the comparison methods indicate that it is possible to think of a single daytime value of the coefficient for this region. The implications of this single value ($\sim 1 \times 10^{-8}$ cm^3/sec) in terms of ionic chemistry are also examined. (auth)

42537 THE ROLE OF THE NONFLARE X RADIATION IN THE D REGION. I. G. Poppoff, R. C. Whitten, and R. S. Edmonds (Stanford Research Inst., Menlo Park, Calif.). J. Geophys. Res., 69: 4081-5(Oct. 1, 1964).

A compilation of short wavelength nonflare solar x-ray spectra is used to evaluate the role of x radiation in the formation of the unperturbed D region. Ionization contributions by solar hydrogen Lyman α and galactic cosmic radiation are compared with the contribution by x radiation. It is concluded that the pronounced dependence of x-ray flux on solar activity results in a model in which the D region is controlled by x radiation. At solar maximum the D region si found to be produced by x radiation and cosmic radiation. Lyman α becomes important at middle D-region altitudes about halfway between solar maximum and minimum. At solar minimum the D region is produced by cosmic, Lyman α, and x radiation in the lower, middle, and upper altitudes, respectively. (auth)

42538 TEMPERATURE VARIATIONS IN THE UPPER ATMOSPHERE DURING GEOMAGNETICALLY QUIET INTERVALS. L. G. Jacchia and J. Slowey (Smithsonian Institution Astrophysical Observatory, Cambridge, Mass.). J. Geophys. Res., 69: 4145-8(Oct. 1, 1964).

The drag analysis of low-perigee satellites such as Injun 3 and Explorer 17 at a time of low solar activity has revealed appreciable fluctuations in upper-atmosphere temperature during geomagnetically undisturbed intervals. These temperature variations are very nearly proportional to the variations in the K_p index, in contrast with the temperature variations during magnetic storms, which show proportionality with the α_p index. When $K_p < 3$, the temperature increase corresponding to a unit increase in K is about 35°. This corresponds to a value of $dT/d\alpha_p$ close to 7°, six or seven times larger than that found in magnetic storms. Since the average value of K_p outside magnetic storms is about 2, the temperature on relatively undisturbed days must be about 70° higher than that corresponding to $K_p = 0$. This again raises the question whether no heat source other than solar euv radiation is present when $K_p = 0$. (auth)

42539 GEOMAGNETIC AND SOLAR DATA. J. Virginia Lincoln, ed. (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 69: 4155-6(Oct. 1, 1964).

The characteristics of geomagnetic storm sudden commencements for 1962 are presented. Geomagnetic and solar data for May 1964 are also included. (C.E.S.)

42540 PENETRATION THROUGH THE MAGNETOPAUSE AND TRAPPING IN ITS VICINITY. Ruth Gall (National Univ. of Mexico, Mexico City). J. Geophys. Res., 69: 4157-61(Oct. 1, 1964).

The penetration into the magnetosphere and the mechanism of trapping in the vicinity of the magnetopause is described for a model in which the interplanetary field is zero and the geomagnetic field within the magnetosphere is represented by the magnetic dipole. (C.E.S.)

42541 A SEARCH FOR CORRELATION BETWEEN K_p AND THE LUNAR PHASE. F. C. Michel, A. J. Dessler, and G. K. Walters (Rice Univ., Houston, Tex.). J. Geophys. Res., 69: 4177-81(Oct. 1, 1964).

A search was made for a correlation between the K_p index and the lunar phase by analyzing a 30-year accumulation of three-hour average K_p determinations. No correlation was found within statistical deviations. (C.E.S.)

42542 K_p AS A PLANETARY INDEX. F. C. Michel (Rice Univ., Houston, Tex.). J. Geophys. Res., 69: 4182-3 (Oct. 1, 1964).

The planetary index K_p derived from the K indexes of indexes of individual observatories throughout the world is discussed. It is concluded that for practical purposes K_p in indeed a true planetary index, although for special considerations it may be useful to apply a small correction. (C.E.S.)

42543 GEOGRAPHICAL DISTRIBUTION OF RADIATION INTENSITY IN THE VICINITY OF BRAZILIAN MAGNETIC ANOMALY AT 300 km ELEVATION. S. N. Vernov, V. E. Nesterov, I. A. Savenko, P. I. Shavrin, and K. N. Shavrina. Kosmich. Issled., 2: 485-91(May-June 1964). (In Russian)

The data produced by Cosmos-7 and -15 on the distribution of radiation intensity in the vicinity of the Brazilian magnetic anomaly were correlated with the data from Cosmos-3 and -5 and Discoverer 31. (R.V.J.)

42544 INVESTIGATION OF EARTH'S RADIATION BELTS IN THE VICINITY OF THE BRAZILIAN MAGNETIC ANOMALY AT THE ELEVATION OF 235 TO 345 km. S. N. Vernov, V. E. Nesterov, N. F. Pisarenko, I. A. Savenko, O. I. Savun, P. I. Shavrin, and K. N. Shavrina. Kosmich. Issled., 2: 492-7(May-June 1964). (In Russian)

Investigations of Earth's radiation belts in the vicinity of the Brazilian magnetic anomaly were carried out with the Cosmos-4, -7, and -9 using Geiger and scintillation counters. The data obtained are tabulated and correlated with other data. (R.V.J.)

42545 AURORAL MORPHOLOGY. C. T. Elvey (Univ. of Alaska, College). Planetary Space Sci., 12: 783-97 (Aug. 1964).

A review is made of auroral morphology, defining morphology in the broader sense to be a description of the auroral display. It is noted that there are several classes of displays which may be considered independent—polar-glow aurora, polar-cap aurora (discrete), red auroral arcs, and polar aurora (conventional). The polar auroras were studied as complete displays by Davis using statistical methods and by Akasofu using individual displays. Davis arrives at a concept for the display as a fixed pattern under which the Earth rotates, while Akasofu believes that the display consists of a system of stable arcs which are disrupted by as yet unknown forces from one to several times during a night. The latter appears to be the more promising. 61 references. (auth)

42546 AURORAL MORPHOLOGY. I. THE LOCATION OF THE AURORAL ZONE. Y. I. Feldstein (World Data Center, Moscow). Tellus, 16: 252-7(May 1964).

An analysis of aurora distribution in the northern and southern hemispheres was made according to results of photo-observations for auroras. The auroral zone is of an oval form, approaching the geomagnetic pole ($\phi' \sim 78°$) at day hours and withdrawing from the pole ($\phi' \sim 68°$) at night hours. The location of auroral zones in the northern and southern hemispheres at day and night hours are given. (auth)

42547 AURORAL MORPHOLOGY. II. AURORAL AND GEOMAGNETIC DISTURBANCES. Y. I. Feldstein (World Data Center, Moscow). Tellus, 16: 258-67(May 1964).

Data from visual observations at middle latitudes give information on the southern boundary of aurora appearance in zenith. Comparison of the aurora zone location with the linear current in the ionosphere and with the magnetic disturbance is made. Current orientation in the ionosphere and the aurora arc direction are considered. (auth)

42548 LECTURES ON MAGNETOIONIC THEORY. K. G. Budden. Documents on Modern Physics. New York, Gordon and Breach Science Publishers, 1964. 88p. $1.95 (paper); $3.95 (Cloth).

Magnetoionic theory, the study of the propagation of electromagnetic waves in an ion plasma with a superimposed constant magnetic field, is applied to the propagation of radio waves in the ionosphere and exosphere. The theory is also extended to deal with media that vary in space. The reflection from a stratified system, such as the ionosphere, is studied, and the guiding of waves by ion structures is examined. An outline of the basis and main uses of the Phase Integral Method in radio propagation problems is given. (C.E.S.)

42549 SOLAR PLASMA, GEOMAGNETISM, AND AURORA. Sydney Chapman. Documents on Modern Physics. New York, Gordon and Breach Science Publishers, 1964. 148p. $1.95(Paper); $4.95(Cloth).

Geomagnetism and related phenomena, the solar plasma on its way to the earth, the mutual influence of the solar gas and the geomagnetic field, magnetic disturbances and aurora, and the ring current and its field are discussed. (C.E.S.)

42550 THE INTERACTION OF THE GEOMAGNETIC FIELD AND THE SOLAR CORPUSCULAR RADIATION.

Ronald Blum. Thesis, Stanford, Calif., Stanford Univ., 1963. 162p.

The solar corona is continually expanding throughout the solar system in the form of a tenuous, fully ionized plasma. This plasma interacts with the geomagnetic field to confine it within a finite cavity in the expanding plasma. The experimental evidence for this interaction is reviewed in detail, and the theoretical basis for the interaction is developed. The central problem of this work is the determination of the free boundary that separates the geomagnetic field from the plasma. An approximate procedure, the co-location method, is constructed to derive solutions for a steady-state, idealized model of the interaction. The idealized model assumes a source of magnetic field immersed in the streaming plasma that encloses the field in a plasma-free cavity, the magnetosphere. Within the cavity the field potentials satisfy Laplace's equation. On the surface of the magnetosphere two boundary conditions are satisfied. The co-location method developed here consists in finding two one-parameter families of surfaces, each family satisfying one of the two boundary conditions identically. The first or F-family involves the vector potential; the second or G-family involves the scalar potential of the field in the magnetosphere. The potentials are expanded in a series of solutions of Laplace's equation appropriate to the geometry and the source field. The series coefficients are undetermined and are found by requiring that the F-surface and the G-surface intersect at a number of arbitrarily selected points. The basic assumption of the method is that if the F- and G-surfaces approximately coincide over a region whose dimensions are at least of the order of the dimensions of the magnetosphere, then they also approximately coincide with the actual free boundary in that region. This method was applied to five different types of sources. (Dissertation Abstr., 25: No. 1, 1964)

Low Temperature Physics

Refer also to abstracts 42020, 42062, and 42346.

42551 (ORNL-P-421) METHOD FOR OBTAINING SECOND DERIVATIVES IN ELECTRON TUNNELING. J. W. T. Dabbs (Oak Ridge National Lab., Tenn.). [Sept. 2, 1964]. Contract W-7405-eng-26. 7p. (CONF-651-10)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

A method for obtaining d^2I/dv^2 in superconductor-insulator-superconductor tunneling junctions is described. The circuit used features a locked-phase oscillator system and identical plug-in operational d-c transistor amplifiers. Junction capacity effects were omitted in the analysis. (R.E.U.)

42552 (SEL-63-128) THE QUANTIZER: AN APPLICATION OF QUANTIZATION OF TRAPPED FLUX IN SUPERCONDUCTORS. Technical Report No. 4717-1. D. J. Dumin (Stanford Univ., Calif. Solid-State Electronics Lab.). Dec. 1963. Contract AF33(616)-7726. 52p. (AL-TDR-64-28; AD-600177).

Recent experimental evidence has shown that the flux trapped by a superconductor is quantized. The fundamental unit of trapped flux is $\Phi_q = h/2e \cong 2 \times 10^{-7}$ gauss cm^2 = 2×10^{-15} webers. This value of flux is quite small and in general the field associated with a unit of flux is also small (<1 gauss). Using present thin-film technology, it is possible to produce quantizing structures with flux-trapping loops of the order of 2.5×10^{-8} cm^2. These loops have a field of a few gauss associated with each flux unit. This field is easily detected with superconductors. A completely superconducting system for the trapping and detecting of these quantum values of flux is described. The quantizer and its operating characteristics are described. Up to six levels of flux have been trapped and detected. A short discussion of material properties, speed considerations, and circuit applications is presented. (auth)

42553 DEGRADATION OF CRITICAL CURRENTS IN NIOBIUM–25% ZIRCONIUM WIRE DUE TO TEMPERATURE CYCLING. S. H. Minnich (General Electric Co., Schenectady, N. Y.). Brit. J. Appl. Phys., 15: 1115-17(Sept. 1964).

The critical current in commercial Nb–Zr wire was measured as a function of applied magnetic field before and after temperature cycling similar to that used for curing Formvar and polyester magnet wire insulations. After cycling, definite and repeatable degradation and anomalies in short-sample characteristics were observed. Coils wound with non-heated wire did not perform significantly better than coils wound with wire insulated with polyester. (D.C.W.)

42554 DEVELOPMENT OF SUPERCONDUCTING MAGNETS. W. F. Gauster. Electron. Power, 10: 64-7 (Mar. 1964).

The state of the art of superconducting magnets is reviewed. Prospects for future improvements are noted. Characteristics of Nb_3Sn and Nb–Zr coils are discussed. Means for protecting coils against damage caused by the superconducting–normal transition are outlined. (T.F.H.)

42555 USE OF SUPERCONDUCTORS FOR EXCITING ELECTRICAL MACHINES. E. Ya. Kazovskii and V. P. Kartsev. Elektrichestvo, No. 6, 74-6(June 1964).

The application of superconductivity in excitation devices for electrical machinery appears extremely promising, due to its intrinsic magnetic self-regulation that affords machines a high static and dynamic stability, and the absence of ohmic losses promotes motor efficiency. An experimental d-c motor, with a superconducting Nb–Sn coil, was constructed. The machine has a 4.2°K section, enclosed in a copper Dewar, and a room temperature section. The latter consists of a double-gap Armco horseshoe magnetic conductor; one gap accommodates the superconducting exciter coil, the other an ordinary d-c rotor. In the experimental study the rotor motion was monitored by a stroboscope. Other experimental details are given as well as a photograph of the set-up. Internal and external characteristics are shown by volt-ampere curves at speeds up to 3000 rpm and above. Results indicate that there is about 20 times more voltage using the superconducting coil as compared with a permanent magnet, and that maximum power is about 200 times greater. The voltage drops somewhat during operation for some, as yet, unexplainable reason. (OTS)

42556 BELOW ONE DEGREE. James Nicol and Conrad J. Rauch. Ind. Res., 60-6(Sept. 1964).

The question of why temperatures below 1°K are valuable to research is briefly discussed, and methods for obtaining these temperatures are outlined. Adiabatic demagnetization, measurement of temperatures of only a few microdegrees above absolute zero, and the behavior of solids below 1°K are discussed. (C.E.S.)

42557 LIQUID-VAPOR EQUILIBRIUM IN THE SYSTEM EQUILIBRIUM HYDROGEN–HELIUM. R. E. Sonntag, G. J. Van Wylen, and R. W. Crain, Jr. (Univ. of

Michigan, Ann Arbor). J. Chem. Phys., 41: 2399-2402 (Oct. 15, 1964).

Liquid-vapor equilibrium-phase compositions for the binary system 20.40°C equilibrium hydrogen–helium were determined for six isotherms in the range 20.40–31.50°K and at pressures up to 500 psia. The vapor recirculation method of obtaining equilibrium was used in conjunction with a liquid-hydrogen vapor-pressure-controlled cryostat. Analyses were made on a mass spectrograph. The results are presented in both tabular and graphical form, and comparisons with those reported previously for the system normal hydrogen–helium were also made. (auth)

42558 SOME EXPERIMENTS ON HEAT TRANSFER AND MAGNETISM BELOW 1°K. VI. SOME EXPERIMENTS ON NUCLEAR ORIENTATION IN MAGNETICALLY ORDERED TUTTON SALTS. A. R. Miedema. Koninkl. Ned. Akad. Wetenschap., Proc., Ser. B, 64: 263-73(1961).

The orientation of ^{60}Co and ^{54}Mn in CoNH$_4$- and MnNH$_4$-tutton salts at low temperatures was investigated by measurement and analysis of gamma intensities. (D.C.W.)

42559 DISSIPATIVE SURFACE CURRENTS IN A SUPERCONDUCTOR OF THE SECOND KIND. P. R. Doidge and Kwan Sik-Hung (Battersea Coll. of Tech., London). Phys. Letters, 12: 82-4(Sept. 15, 1964).

The superconducting transition characteristics of a rod of In–38 at. % Tl, which is known to have fcc structure at all temperatures and to be a second-type superconductor, are studied by a-c techniques at 0 to 150 Oe. The effects of electropolishing the surfaces of the rod are determined. The complex a-c permeability is measured at 23 to 1245 cps. It is concluded that there is a dissipative mechanism associated with the flux changes inside the rod. (T.F.H.)

42560 THE EFFECT OF RATE OF CHANGE OF MAGNETIC FIELD ON FLUX-JUMPING IN Nb$_3$Sn CYLINDERS. J. M. Corsan (General Electric Co. Ltd., Wembley, Middx, Eng.). Phys. Letters, 12: 85-6(Sept. 15, 1964).

Nb$_3$Sn cylinders having a density of 6 g/cm^3 are fabricated by pressing and sintering, and are machined into tubes having 0.10 cm ID and 0.60 and 0.69 cm OD. The magnitude of the flux jumps in these tubes is found as a function of rate-of-rise of magnetic field, from 2 to 20 kOe/min. Fluxes as high as 52 kOe have been trapped in these tubes, by rapidly increasing the applied magnetic field and then very slowly decreasing the applied field. (T.F.H.)

42561 PERIODIC DISCONTINUITIES IN THE DRIFT VELOCITY OF IONS IN LIQUID HELIUM II. G. Careri, S. Cunsolo, and P. Mazzoldi (Università, Rome). Phys. Rev., 136: A303-10(Oct. 19, 1964).

The drift velocity of positive and negative ions in liquid helium around 1°K was studied by the time-of-flight method as a function of the applied field. Sharp and periodic discontinuities were detected at values which are integer multiples of $\langle v_c \rangle = 5.2 \pm 0.2$ m/sec for positive ions, and $\langle v_c \rangle = 2.4 \pm 0.1$ m/sec for negative ones. Metastable mobility levels induced by bath disturbances were also detected. Analysis of these results, together with the ones obtained by the heat-flush method, shows this process to be due to single ions which suffer additional interaction with the roton gas when their drift velocity relative to the background fluid reaches the observed critical velocities. A tentative model is proposed which explains these results by assuming vortex rings of different quantum numbers of circulation to be closely bound to the ion in motion, which interact with the roton gas via their velocity field. (auth)

42562 CRITICAL VELOCITIES OF IONS IN LIQUID HELIUM II DETECTED BY HEAT FLUSH. G. Careri, S. Cunsolo, and M. Vicentini-Missoni (Università, Rome). Phys. Rev., 136: A311-15(Oct. 19, 1964).

The discontinuity in the drift velocity of ions in liquid helium, previously detected by the time-of-flight method, is confirmed by the heat-flush method in a wide channel. The critical velocity is found to be $\langle v_c \rangle = 4.96 \pm 0.35$ m/sec independent of beam geometry and of ionic density. The detailed analysis of the beam displacement in the two-fluid counterflow process allows one to conclude that the new dissipation suffered by the beam at $\langle v_c \rangle$ is essentially due to its interaction with the normal fluid. (auth)

42563 MAGNETIZATION OF SUPERCONDUCTING Nb–25% Zr WIRE. W. A. Fietz, M. R. Beasley, J. Silcox, and W. W. Webb (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 136: A335-45(Oct. 19, 1964).

The magnetization and critical transport-current densities of samples of superconducting niobium–25% zirconium cold-worked wire were measured quantitatively up to 40 kOe applied field. All of the magnetization characteristics, as measured by several techniques, and the critical transport currents conform to critical-state concepts provided that the equilibrium magnetization is included in the analysis. The equilibrium magnetization curves could be deduced from the hysteretic measured magnetization data, and the results agree with the theory of Abrikosov for type-II superconductors. The irreversible magnetization-current densities $J_c(B)$, where B is the local magnetic induction, just equal the critical transport-current densities $J_t(H)$ in the range 4 to 40 kOe applied field. They are accurately fitted by an empirical critical-state expression of the form $J_c(B) = a_0 \exp(-B/b_0) + c_0$ where a_0, b_0, and c_0 are measured constants of the material. The methods used appear to be generally applicable to the study of hysteretic superconducting wire. (auth)

42564 APPARENT LACK OF LONG-RANGE ORDER IN SUPERCONDUCTING VANADIUM. L. Meyers and W. A. Little (Stanford Univ., Calif.). Phys. Rev. Letters, 13: 325a-7a(Sept. 14, 1964).

An attempt is made to investigate the presence of off-diagonal long-range order in V and Nb, by measuring the periodicity of the superconducting transition temperatures in cylinders of these elements as a function of the magnetic flux within the cylinders. No such periodicity is observed. It is therefore concluded that no off-diagonal long-range order exists in V or Nb. Theoretical implications of this negative result are discussed. (T.F.H.)

42565 SPECULAR REFLECTION OF PHONONS IN SUPERFLUID HELIUM AT 0.33°K. J. Fajans and C. Z. Rosen (Stevens Inst. of Tech., Hoboken, N. J.). Phys. Rev. Letters, 13: 328a-9a(Sept. 14, 1964).

Two carbon electrodes, each of which is in the form of a 90° arc of a right circular cylinder, are placed in a superfluid-He bath at 0.33°K. The electrodes are positioned as though four such electrodes had been placed in a circle, and two opposite electrodes then removed. One of the electrodes acts as a phonon transmitter, and the other as a receiver. The electrodes have a radius of curvature of 0.05 in. on the inner face. Also in the bath is a fused quartz mirror in the form of a concave hemisphere of radius 0.5 in. When the mirror is sharply focused, so that the carbon receiver is conjugate to the transmitter, an enhanced signal 14 times greater than the background signal is observed. This enhanced signal is concluded to result from specular reflection of phonons. (T.F.H.)

42566 CRITICAL-FIELD BEHAVIOR OF A MICROSCOPIC SUPERCONDUCTING BRIDGE. R. D. Parks, J. M. Mochel, and L. V. Surgent, Jr. (Univ. of Rochester, N. Y.). Phys. Rev. Letters, 13: 331a-3a(Sept. 14, 1964).

A technique is described for producing superconducting bridges about 1 to 5μ wide and 1 to 50μ long in superconducting films about 0.1μ in thickness. Pronounced anomalies are observed in the critical field behavior of these samples, which can be interpreted in terms of a reduction of the free energy of a microregion of the sample that occurs when quantized vortices are allowed to enter this region. Other theoretical explanations for this phenomenon are found to be less satisfactory than the vortex explanation. (T.F.H.)

42567 QUADRUPOLE POINT OF He^3-He^4 MIXTURES. P. M. Tedrow and D. M. Lee (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters, 13: 388-90(Sept. 28, 1964).

The results of strain-gage measurements of the freezing curves of dilute mixtures of ^3He in ^4He are described. At temperatures below about 0.37°K, these curves can have positive slopes suggesting the existence of a quadrupole point in agreement with the phase diagram proposed earlier. (C.E.S.)

42568 CRYSTAL STRUCTURE OF SUPERCONDUCTING V_3Si. B. W. Batterman and C. S. Barrett (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Letters, 13: 390-2 (Sept. 28, 1964).

The discovery of a martensitic phase transformation at low temperatures for the superconducting compound V_3Si and observations suggesting that related transformations occur in other substances having the β-tungsten (A-15) structure are reported. (C.E.S.)

42569 ELECTRON PAIRS IN THE QUASICHEMICAL-EQUILIBRIUM AND BARDEEN-COOPER-SCHRIEFFER THEORIES. A. J. Coleman (Queen's Univ., Kingston, Ont.). Phys. Rev. Letters, 13: 406-7(Sept. 28, 1964).

Electron pairs in quasichemical equilibrium are discussed in an attempt to clear up ambiguities concerning the definition of Fermi pairs of a superconducting system and misconceptions about Fermi pair statistics. (C.E.S.)

42570 OBSERVATION OF THE λ ANOMALY IN SOLID D_2 BY NUCLEAR MAGNETIC RESONANCE. J. R. Gaines, E. M. de Castro, and David White (Ohio State Univ., Columbus). Phys. Rev. Letters, 13: 425-6(Oct. 5, 1964).

Splitting of the resonance line in solid D_2 was observed below about 2°K in NMR studies of D_2 samples enriched to about 80% in para D_2. (D.C.W.)

42571 MEASURING PRECISELY NEAR ABSOLUTE ZERO: HELIUM-3 AND LOW-TEMPERATURE THERMOMETRY. W. J. Haubach and W. L. Taylor (Monsanto Research Corp., [Miamisburg, Ohio]). Res. Develop., 15: No. 9, 19-23(Sept. 1964).

Most of the conventional temperature measuring devices are unsuitable for cryogenic work. In seeking to establish a standard reaching almost to absolute zero, the helium-3 vapor pressure thermometer is being used to measure the range between 0.3 and 3.2°K. Helium-3 is more desirable than helium-4 as a primary standard of thermometry for several reasons, which are outlined. (auth)

42572 LABORATORY SYSTEM FOR THE TRANSFER OF 4.2°K LIQUID HELIUM INTO A BELOW-λ REGION. Hannibal H. Madden and Henry V. Bohm (Wayne State Univ., Detroit). Rev. Sci. Instr., 35: 1554-6(Nov. 1964).

A laboratory system for the transfer of 4.2°K liquid helium into a below-λ region is described. The device operates on the principle of flash-evaporation of 4.2°K liquid through a needle valve into a region of below-λ temperature. It is designed for easy installation on most experimental cryostats. Factors affecting transfer efficiency, currently greater than 20%, are discussed. (auth)

42573 THE GENERALIZED GINZBURG-LANDAU-GOR'KOV EQUATIONS FOR A PURE SUPERCONDUCTOR. L. Tewordt (Universität, Hamburg). Z. Physik, 180: 385-91(1964).

The fourth-order contributions to the generalized Ginzburg-Landau-Gor'kov (GLG) gap equation and to the corresponding free energy functional were calculated using a general method which was developed previously. A comparison of the magnitudes of the fourth- and second-order terms leads to the general conclusion that the GLG type of theory is applicable only if the gap and the vector potential vary slowly over BCS coherence distances. The fourth-order terms can be used as correction terms to the second-order terms when the GLG theory is extended from temperatures just below T_c to lower temperatures. (auth)

42574 ABSORPTION OF HIGH-FREQUENCY ENERGY IN A SUPERCONDUCTING Nb–Zr ALLOY. N. I. Krivko (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 34: 1337-9(July 1964). (In Russian)

High-frequency absorption in a superconducting resonator was measured as a function of the magnitude of the external magnetic field. The specimens of Nb–Zr alloy were prepared from 60 wt % Nb and 40 wt % Zr. The measurements were carried out at 4.2°K and 9250 mHz frequency. Tests of seven Nb–Zr alloy specimens (content variation not over 1.5%) showed quite a variable behavior of the specimens in a high-frequency field. For two specimens the high-frequency energy absorption as a function of the external magnetic field had a resonance character. For the two other specimens the increase in absorption was observed in a magnetic field with simultaneous increase in resonator frequency. In the rest of the specimens only the resonator frequency changed with the specimen depending on the external field. (R.V.J.)

42575 THERMAL PHASE TRANSITIONS IN SUPERCONDUCTING NbZr ALLOYS. Clayton Newton Whetstone. Thesis, Nashville, Vanderbilt Univ., 1964. 78p.

Experimental data on the thermal propagation of a superconducting-normal boundary along a 10-mil wire are presented for Nb-25%Zr, Nb-33%Zr, and Nb-50%Zr. The thermal velocity was found to be a linear function of current both at 4.2°K in magnetic fields as high as 80 kgauss and in a zero magnetic field at bath temperatures between 2.5 and 11°K. Previous models describing thermal propagation neglect the temperature dependence of the specific heat, thermal conductivity, and electrical resistivity. A model is proposed that takes into account the temperature dependence of these quantities. An expression is obtained, which shows that the thermal propagation velocity is only dependent on the transition temperature of the superconductor and the temperature of the bath surrounding the sample. All the data are in agreement with the proposed model, and the experimental data showing the dependence of the thermal velocity on magnetic field are used to calculate the transition temperature as a function of magnetic field. The experimental data on the thermal velocity and the proposed model show that the volume of the superconducting phase is not changed by the application of large transport currents and high magnetic fields. A method for measuring the superconducting specific heat in the presence of large transport currents and high magnetic fields is provided. In addition to the thermal transition, a fast transition was observed that will drive a sample completely normal in 10^{-5} seconds. This fast transition is used as the criterion to measure the critical current. The effect that the thermal transition has on the measurement of the critical current is discussed. Pulsed and d-c values for the critical current are compared up to 70 kgauss at 4.2°K and pulsed values for the critical current as a function of bath temperature are presented. (Dissertation Abstr., 25: No. 1, 1964)

Neutron Physics

Refer also to abstract 41762.

42576 (AERE-R-4553) SPECIFIC—A MONTE CARLO PROGRAMME FOR HIGH-ENERGY NEUTRON SPECTRUM ESTIMATION. M. P. Ruffle (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1964. 20p.

SPECIFIC is a Monte Carlo code, written in FORTRAN for the IBM 7030, for estimating the high-energy neutron spectrum resulting from a fission source in cylindrical (r,z) geometry. Estimates are made of the variances of the results, and an option is available for integrating tabulated functions over the spectra produced. (auth)

42577 (AWRE-O-32/64) THE MECHANIZED APPLICATION OF PERTURBATION THEORY IN MULTIGROUP NEUTRON TRANSPORT CALCULATIONS. E. D. Pendlebury (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). July 1964. 43p.

The mechanized application of first-order perturbation theory to multigroup neutron transport problems is discussed with particular reference to the IBM 7090 program PERTH and the IBM 7030 (STRETCH) program STRAINT. The results of test calculations, which give an indication of the range of validity of first-order perturbation theory, are also described. (auth)

42578 (BLG-230) PROGRAMME TRHEX—A TWO-DIMENSIONAL TRIANGULAR MESH DIFFUSION PROGRAMME FOR THE FERRANTI MERCURY COMPUTER. R. de Meersman (Centre d'Étude l'Énergie Nucléaire, Brussels). Nov. 1963. 29p.

TRHEX is a program for a two-drum Mercury computer. It solves the multigroup diffusion equations in a triangular mesh system. The outer boundary must be a hexagon. There is no acceleration on the convergence of the outer iterations. For the inner iterations, a point successive over-relaxation is used. (auth)

42579 (BLG-260) NEUTRON FILTERS FOR THERMAL OR COLD NEUTRON BEAMS. W. Van Dingenen and S. Hautecler (Centre d'Étude l'Énergie Nucléaire, Brussels). Oct. 1963. 34p.

Cold neutron transmission in polycrystalline materials was studied; included were Be, BeO, Pb, Bi, graphite, and quartz. Thermal neutron transmission by monocrystalline Be, MgO, SiO_2, Pb, and Si was studied. Measurements were made at 293 and 77°K. (R.E.U.)

42580 (BNL-7812) THE WKB METHOD IN THE STUDY OF NEUTRON THERMALIZATION IN GRAPHITE. Ajoy K. Ghatak (Brookhaven National Lab., Upton, N. Y.). Feb. 1964. Contract AT-30-2-GEN-16. 7p. (CONF-446-25)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

WKB calculations of the thermal neutron spectra and other related quantities in graphite were made with the knowledge of only one function P(E). The thermal spectra were calculated also for a graphite assembly containing a 1/v absorber. (R.E.U.)

42581 (CEA-R-2476) ETUDE DE LA MIGRATION DES NEUTRONS DANS UN MILIEU MULTIPLICATEUR EN FONCTION DE L'INTENSITE ET LA DISTRIBUTION DES CAPTURES. (Study of Neutron Migration in a Multiplying Medium According to the Intensity and Distribution of Absorptions). Roger Naudet (France. Commissariat à l'Energie Atomique. Centre d'Études Nucléaires, Saclay). Aug. 1964. 54p.

The parameters of the problem were studied successively (thermalization model, absorption law, variation law of the diffusion coefficient, geometrical parameters of the cell, relative importance of the leakages), and numerical applications are presented. (auth)

42582 (CEA-R-2515) CALCUL DU TEMPS DE VIE DES NEUTRONS THERMIQUES DANS UN MODERATEUR HETEROGENE: GRAPHITE–CADMIUM. VERIFICATION EXPERIMENTALE PAR LA METHODE DES NEUTRONS PULSES. (Calculation of the Lifetime of Thermal Neutrons in a Heterogeneous Moderator, Graphite–Cadmium. Experimental Verification Using the Pulsed Neutron Method). Jean Lalande (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). July 1964. 11p.

The heterogeneous medium is made up of an oblong assembly consisting of 23-cm cells containing a cadmium bar having a diameter of 3.31 cm. The experimental value found for the lattice absorption (941 sec) is in agreement with the value calculated from one-group theory for one cell taking (2.55 ± 0.12) cm for the extrapolation distance in the cadmium rod. (auth)

42583 (GEAP-4547) TRANSPORT EQUIVALENT DIFFUSION THEORY. Quarterly Progress Report No. 1, April 1–June 30, 1964. G. H. Kear (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). July 31, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 26p. (EURAEC-1180)

It is shown that the elementary diffusion coefficient can be modified into a spatially dependent function so that solutions of the diffusion equation will reproduce solutions of the transport equation for the first two moments of the angular flux, i.e., the total flux and the current. Preliminary calculations with simple geometries (the slab and sphere) are reported, the question of boundary conditions is discussed, and the required spatially dependent diffusion coefficient is exhibited. Continued work is planned with the objective of finding a recipe for determining the spatially dependent coefficient which is reasonably simple, and, at the same time, accounts for the transport corrections with appropriate accuracy. (auth)

42584 (IAE-597) PRYAMOI METOD IZMERENIYA POLYARIZATSII PUCHKA MEDLENNYKH NEITRONOV. (Direct Method of Measuring the Polarization of a Beam of Slow Neutrons). B. G. Erozolimskii, Yu. A. Mostovoi, and B. A. Obinyakov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 8p.

Separation of a polarized slow neutron beam in a strong inhomogeneous magnetic field was used for measuring the degree of polarization. The obtained results indicate $p = 80 \pm 1.5\%$. (tr-auth)

42585 (KAPL-3013) DRAM: A MONTE CARLO PROGRAM FOR THE CALCULATION OF CAPTURE PROBABILITIES. G. J. Habetler, R. A. Pfeiffer, and J. E. Tuecke (Knolls Atomic Power Lab., Schenectady, N. Y.). June 15, 1964. Contract W-31-109-eng-52. 80p.

DRAM is a two- and three-dimensional neutron transport calculation for Monte Carlo determination of spatial and spectral variation of neutron population. Scattering kernels and cross sections are obtained from a tape library. Scattering is from discrete energy to discrete energy, the energies being defined by the group structure. Library data are available for 5530 to 0.0 ev and 0.625 to 0.0 ev for various temperatures. Adjoint calculation is available as an option. (auth)

42586 (KEA-114) PROGRAMMBESCHREIBUNG ZU DANCOFF JR. IBM 7040. (Program Description for Dancoff Jr. IBM 7040). H. Gellings and A. Sauer (Allgemeine Elektrizitatsgesellschaft, Frankfurt am Main). Apr. 1964. 46p.

The FORTRAN IV program, Dancoff Jr., is used for the determination of the desired distribution functions of the zero and first order of moderator spaces and some of their moments, including the darkening in usual and unusual lattices of cylindrical fuel rods with claddings of various effective cross sections. The following lattice types were proposed: infinitely expanded quadratic and hexagonal lattice; infinitely expanded quadratic lattice with a straight or cruciform gap; and two-, three-, seven-, or nine-rod bundles. The angular distribution of the neutrons from the fuel elements is $\sim(\underline{n} \cdot \Omega)^m$; the orders $m = 0$ (isotropy) and $m = 1$ are permitted. The following parameters were calculated: the desired distribution function, the mean desired length, the quadratic moment, the logarithmic moment, and the darkening. (tr-auth)

42587 (NP-14349) THE SKIP THREE-DIMENSIONAL REACTOR COMPUTER PROGRAM. R. Prescott, J. J. Walsh, and A. B. Whiteley (Gt. Brit. Central Electricity Generating Board, London). May 1963. 41p. (CD/NS/10)

SKIP, a FORTRAN program written for a two-channel IBM 7090 with six tape units per channel, solves the few-group diffusion equations in three-dimensions, together with the associated thermal equations appropriate to a large gas-cooled, graphite-moderated, natural-uranium power reactor. FAP routines are used for input-output sections of the program. The partial differential equations defining the neutron flux distribution and axial temperature distribution are solved by finite difference methods based on a cartesian mesh. The finite-difference flux equations are solved iteratively using a point method, and convergence is accelerated by applying Chebyshev extrapolation to the source. Extensive data checking and output editing routines are also features of the program. (R.E.U.)

42588 (ORNL-TM-957) MESH SPACING IN CYLINDRICAL GEOMETRY FINITE DIFFERENCE CALCULATIONS IN DIFFUSION THEORY. M. Tobias (Oak Ridge National Lab., Tenn.). Sept. 15, 1964. Contract [W-7405-eng-26]. 7p.

The advisability of keeping mesh spacing uniform is illustrated by an elementary analysis of the errors involved in two typical examples of the finite difference analog of the diffusion equation in one-dimensional cylindrical geometry. One of these difference equations is used in WANDA and the other in CURE and EQUIPOISE. The answers obtained with these equations are compared with the analytically obtained result for a simple problem. While it appears that mesh spacing ought to be uniform within a region of uniform composition, the question of the mesh spacing ratio between two different regions appears too complex to make any definite recommendations. (auth)

42589 (PAN-503/IX-A) KONTROP'NYE IZMERENIYA DIFFUZIONN'KH PARAMETROV NEITRONOV V VODE METODOM IMPULYSNOGO NEITRONNOGO ISTOCHHIKA. (The Control Measurements of the Neutron Parameters in Light Water With the Aid of Neutron Pulse Source). Stefan Khvashchevski and Kazimekh Dybovski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1964. 13p.

The decay constant of neutron density in light water was measured using a pulse-neutron source. The calibration of the apparatus and arriving at some measurement practice was the common aim of these measurements. The good agreement of our results with results of others was established. (auth)

42590 (TID-7050(p.15-24)) THE NEUTRON SLOWING-DOWN PROBLEM. D. S. Selengut, ed. (Knolls Atomic Power Lab., Schenectady, N. Y.).

The role of neutron slowing-down calculations in reactor design theory is discussed. (R.E.U.)

42591 (TID-7050(p.89-125)) SLOWING-DOWN THEORY IN A UNIFORM MEDIUM. H. J. Amster (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

The commonly used analytic approximations used in slowing-down theory in transport equation solutions are described. The approximations are made in the computation of the source due to elastic neutron scattering. The use of uniform-medium calculations with spatial dependence removal through the assumption of a cosine spatial dependence of the scalar flux for few-group diffusion theory coefficients is discussed. (R.E.U.)

42592 (TID-7050(p.125-37)) MONTE CARLO AGE CALCULATIONS IN A UNIFORM MEDIUM. H. J. Amster and R. C. Gast (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

The use of Monte Carlo slowing-down calculations as standards for comparison of experimental and calculated values in neutron physics is discussed; age measurements in a uniform medium using a plane source of neutrons are considered. (R.E.U.)

42593 (TID-7050(p.137-54)) RESONANCE CAPTURE. S. Stein (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

A model of a ^{238}U resonance-capture lattice used in slowing-down calculations is described. Cross sections and resonance escape probabilities are calculated. (R.E.U.)

42594 (TID-7050(p.154-75)) MULTIGROUP DIFFUSION THEORY. E. L. Wachspress (Knolls Atomic Power Lab., Schenectady, N. Y.).

A general description of the multigroup formulation in Boltzmann diffusion calculations is given. (R.E.U.)

42595 (TID-7050(p.175-97)) MULTIGROUP TRANSPORT THEORY. R. C. Gast (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

The theory and practice of multigroup transport calculational procedures using the RDR-5 and PREP computer codes are discussed. Angular, lethargy, and spatial differencing treatments are considered. (R.E.U.)

42596 (TID-7050(p.197-229)) FEW-GROUP APPROXIMATIONS. R. L. Hellens (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

A few-group scheme for water moderated reactors, which approximates the competition between fission, capture, and leakage and yields the same results as a multigroup calculation in the limit of a bare core, is described. (R.E.U.)

42597 (TID-7050(p.229-76)) FAST GROUP FITTED CONSTANTS IN FEW-GROUP THEORY. P. A. Ombrellaro (Knolls Atomic Power Lab., Schenectady, N. Y.).

Two schemes for calculating fast few-group constants for core depletion calculations are described. The fitted cross-section scheme expresses the fast group constants in terms of effective microscopic cross sections, which are obtained by fitting the simple group-constant formulas to the group constants obtained from a multigroup program such as MUFT. The second scheme uses a variational method to solve the energy-dependent diffusion equations based on the assumption that, for a given composition, the flux spectrum is adequately given as a linear combination of two flux base spectra, and similarly for the current spectrum, where the bases are chosen to represent soft and hard spectra. The energy range from 10 Mev to 0.625 ev is represented in terms of lethargy, and few-group constants are obtained for a three-, two-, and one-group representation. (R.E.U.)

42598 (TID-7050(p.285-9)) THE NEUTRON THERMALIZATION PROBLEM. R. J. Breen, ed. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Various aspects of neutron thermalization and its application in reactor calculations are discussed. (R.E.U.)

42599 (TID-7050(p.289-330)) INELASTIC SCATTERING OF THERMAL ENERGY NEUTRONS. D. T. Goldman (Knolls Atomic Power Lab., Schenectady, N. Y.).

The Boltzmann equation for inelastic neutron scattering is discussed term-for-term. General methods for calculating the scattering of thermal neutrons by chemically bound particles are given. A pseudopotential approximation is used to treat the chemical motion of the scatters quantitatively for energies near those of the chemical system ($\leq$1 ev). Results are given for water and polyethylene. (R.E.U.)

42600 (TID-7050(p.330-49)) SENSITIVITY TO THE NEUTRON SCATTERING KERNEL. F. D. Federighi (Knolls Atomic Power Lab., Schenectady, N. Y.).

The use of scattering kernels in calculations of infinite-medium and spatially dependent thermal spectra as well as criticality is discussed. Thermal spectra were calculated for water and polyethylene. Comparisons are made between the Nelkin water kernel, the mass 1 kernel, and the Goldman polyethylene kernel. (R.E.U.)

42601 (TID-7050(p.349-78)) MULTIGROUP THEORY. E. M. Gelbard (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh); and N. Francis (Knolls Atomic Power Lab., Schenectady, N. Y.).

The derivation and solution of multigroup transport equations for thermal neutron fluxes are discussed. Techniques used to discretize the energy and angular variables are discussed, and the incorporation of such techniques into computing tools is described. The SLOP-1 and TET computer programs for one-dimension multigroup equations are described. Monte Carlo methods are also discussed. (R.E.U.)

42602 (TID-7050(p.379-409)) APPLICATION OF MONTE CARLO METHODS TO NEUTRON THERMALIZATION. J. Spanier (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh); and G. J. Habetler (Knolls Atomic Power Labs., Schenectady, N. Y.).

Computer programs using Monte Carlo methods for thermal absorption rates and/or thermal fluxes are described. The mathematical backgrounds behind TUT-T5 for IBM 704, TRAM for IBM 704 and Philco 2000, TRAC for Philco 2000, and MARC for Philco 2000 are discussed. In each program, the random variable is the average distance traveled by all the particles in a given volume of phase space. (R.E.U.)

42603 (TID-7050(p.409-48)) BLACKNESS THEORY FOR SLABS. C. W. Maynard (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

The approximation of the neutron flux distribution in a heterogeneous medium containing one or more regions having a large macroscopic absorption cross section, e.g., control rods and lumped poisons, is considered. Comparison is made between low-order approximations and transport solutions. Numerical results are given for slabs of optical thickness 0.25 to 20.00 for cross section ratios (scattering-to-total) of 0.0 to 1.0. (R.E.U.)

42604 (TID-7050(p.448-94)) APPROXIMATIONS TO MULTIGROUP METHODS. G. P. Calame (Knolls Atomic Power Lab., Schenectady, N. Y.); and M. Goldsmith (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

The use of few-group methods to simplify multigroup methods is described. The Radkowsky kernel was chosen for some thermal neutron calculations to illustrate the methods. (R.E.U.)

42605 (TID-7050(p.494-519)) A TWO-MODE VARIATIONAL PROCEDURE FOR CALCULATING THERMAL-DIFFUSION THEORY PARAMETERS. P. A. Ombrellaro (Knolls Atomic Power Lab., Schenectady, N. Y.).

The approximation of variations in the thermal group constants with depletion by a two-mode variational procedure is discussed. The procedure was programmed in FORTRAN for IBM 704 (SPG), and the results were compared with group constants obtained from the SOFOCATE program. (R.E.U.)

42606 (TID-7050(p.552-95)) GENERALIZED TREATMENT OF PARTICLE SELF-SHIELDING. C. H. Randall (Knolls Atomic Power Lab., Schenectady, N. Y.).

A model is developed for a particular case of particles embedded in a matrix material, and provides a relatively rigorous and general theoretical treatment, whereby the behavior of a reactor system containing heterogeneous materials can be predicted by representing the heterogeneities by effective macroscopic cross sections. (R.E.U.)

42607 (TID-7050(p.1414-41)) ITERATION PROCEDURES IN NEUTRON-DIFFUSION CALCULATIONS. G. J. Habetler (Knolls Atomic Power Lab., Schenectady, N. Y.); and L. A. Hageman (Westinghouse Electric Corp Bettis Atomic Power Lab., Pittsburgh).

Inner and outer iteration procedures in the solution of group equations in neutron-diffusion theory are described. (R.E.U.)

42608 (TID-7050(p.1441-61)) THE MATHEMATICS OF MONTE CARLO FOR REACTOR CALCULATION. J. Spanier (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Monte Carlo methods in particle transport problems are described in an attempt to present a unified mathematical theory of sampling procedures. (R.E.U.)

42609 (TID-20165) ITERATIVE METHODS FOR SOLUTION OF DIFFUSION PROBLEMS IN r-θ GEOMETRY. D. B. MacMillan (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 30, 1964. Contract [W-31-109-eng-52]. 12p. (CONF-686-1)

From Association for Computing Machinery, Philadelphia, Aug. 1964.

Three iteration methods for computing approximately a steady-state solution of the diffusion equation, in a pie-shaped region of the plane, using a finite mesh based on the r-θ coordinate system, are compared. The methods are successive line over-relaxation along curves of constant radius, successive line relaxation along radii, and alternating-direction-implicit iteration. It is concluded that the first of these three methods is superior, in that it is expected to converge faster for most problems. (auth)

42610 (UCRL-7630(Rev.1)) REVISIONS TO YOGI-N NEUTRON MONTE CARLO PROGRAM. Simon Kellman (California. Univ., Livermore. Lawrence Radiation Lab.). July 24, 1964. Contract W-7405-eng-48. 30p.

Revisions and corrections to the YOGI-N main program and GPE subroutine are shown. (R.E.U.)

42611 NEUTRON PROPAGATION IN URANIUM CARBIDE. I. I. Bondarenko, V. I. Golubev, A. V. Zvonarev, M. N. Nikolaev, M. Yu. Orlov, and O. P. Uznadze. At. Energ. (USSR), 17: 113-19(Aug. 1964). (In Russian)

Results are presented of experiments on the investigation of neutron spatial-energy distributions in simulative uranium carbide using a heterogeneous assembly of depleted uranium and graphite. The obtained data agree satisfactorily with the results of a many-group calculation. Characteristics spectra in uranium carbide — equilibrium and asymptotic — are surveyed. The maximum breeding coefficient for a fast reactor with a uranium carbide screen is determined to be equal to 2.5 ± 0.2. (tr-auth)

42612 INVESTIGATION OF FAST NEUTRON PASSAGE THROUGH SODIUM. V. K. Daruga, A. N. Nikolaev, D. S. Pinkhasik, B. I. Sinitsyn, and S. G. Tsypin. At. Energ. (USSR), 17: 145-6(Aug. 1964). (In Russian)

Relaxation lengths of neutrons with energies higher than 0.5 Mev in sodium were determined. The characteristics of the detectors used — ^{27}Al, ^{32}S, ^{24}Mg, and proton recoil — are presented. The reactor BR-5 was used as a neutron source. The data were fitted to an attenuation function for a plane infinite monodirectional source; results are presented for each detector. (M.J.T.)

42613 CALCULATION OF THE POLARIZATION CAPACITY OF ZIRCONIUM FOR 3.4-Mev NEUTRONS. F. Buehler (Technische Hochschule, Stuttgart). Helv. Phys. Acta, 37: 241-4(1964). (In German)

The polarization capacity of Zr for 3.4-Mev neutrons was calculated on the basis of the optical model. The potential parameters were chosen so that the theoretical total and differential elastic cross sections would agree with experimental cross sections previously obtained. By assumption of a complex spin-orbit coupling and a second set of parameters, improved agreement of the differential cross section and the polarization capacity with experimental values was obtained. (J.S.R.)

42614 ON THE SUMMATION OF THE DIFFUSION COOLING COEFFICIENT FOR A HEAVY GAS. M. M. R. Williams (Univ. of Birmingham, Eng.). J. Nucl. Energy, Pts. A & B, 18: 452-3(Aug. 1964).

The sum T in the diffusion cooling coefficient $c = DT/2\pi\mu$ is evaluated in terms of definite integrals, the values of which are readily obtained from tables. (D.C.W.)

42615 CHARACTERISTIC SPECTRA IN NEUTRON THERMALIZATION. [PART] II. THE EFFECT OF CHEMICAL BINDING. Akira Furuhashi (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 1: 120-9(July 1964).

The method of modal expansion for the time-dependent thermal neutron spectra was extended to include the effect of chemical binding of heavy moderators. The Laguerre moments in energy transfer were calculated from the generalized phonon frequency spectrum. The heavy gas model was treated as a special case. It is shown that the heavy mass approximation corresponds to neglect of multiple phonon processes in the energy exchange mechanism. Numerical calculations were made for heavy Einstein solids. It was concluded that thermalization time constant diminishes with increasing energy quantum more rapidly than the second moment of the energy transfer kernel. In contrast to the time decay constants, the characteristic spectra are not strongly influenced by chemical binding. It is also shown that the Doppler approximation appreciably underestimates the effect of chemical binding. Finally, diffusion cooling in a chemically bound system is discussed by assuming the energy-independent diffusion constant, and the possibility is suggested that, in a strongly chemically bound system, the first higher mode in energy may decay more slowly than the first higher mode in space. (auth)

42616 ON THE MEASUREMENT OF PHOTONEUTRON MULTIPLICITY. G. C. Bonazzola and S. Costa (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nucl. Instr. Methods, 28: 274-6(Aug. 1964).

A statistical method for measuring photoneutron multiplicity was previously proposed. Some tests on the feasibility of the method are discussed. (D.C.W.)

42617 PRODUCTION OF LARGE 2.5 AND 14-Mev NEUTRON FLUXES. G. E. Velyukhov and A. N. Prokof'ev (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 32-6(July-Aug. 1964). (In Russian)

A description is given of a neutron generator in which deuteron currents to 4.5 mamp are used. On standard deuterium and tritium targets, fluxes of 2.7×10^{11} and 10^{10} n/sec are obtained for $E_n = 14$ and 2.5 Mev, respectively. Comparative characteristics of target operations are presented. The possibility of obtaining neutron currents $\geq 10^{12}$ for $E_n = 14$ Mev is considered. (tr-auth)

42618 EXPERIMENT AND ANALYSIS ON NEUTRON ATTENUATION IN ZIRCONIUM HYDRIDE. W. E. Selph, T. C. Hinkson, and W. J. Rainwater, Jr. (Ling-Temco-Vought, Inc., Dallas). 47p. (CONF-446-34)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

Data are presented on the fast-neutron-attenuating properties of zirconium hydride, and comparisons are made between experimentally and analytically determined values. A LINAC was used to produce neutrons with an energy spectrum approximating that for a fission source. Energy spectral measurements were made of the neutrons incident on and penetrating $ZrH_{1.9}$ slabs of various thicknesses.

Spectral measurements were made as a function of exit angle for a slab of 87 g/cm^2. Analysis of the experimental results was performed with the ADONIS Monte Carlo program. In addition, the experimental results were analyzed with the GAPLSN transport program. (auth)

Nuclear Properties and Reactions

Refer also to abstracts 42359, 42428, and 42436.

42619 (AE-150) INELASTIC NEUTRON SCATTERING CROSS SECTIONS OF Cu^{63} AND Cu^{65} IN THE ENERGY REGION 0.7 TO 1.4 Mev. B. Holmqvist and T. Wiedling (Aktiebolaget Atomenergi, Stockholm). Aug. 1964. 31p.

The gamma spectra from the reactions ^{63}Cu(n,n′γ) and ^{65}Cu(n,n′γ) were studied for seven neutron energies from 0.7 to 1.4 Mev using a NaI(Tl) scintillation spectrometer and time-of-flight techniques. Scatterers of natural copper were used. Experimental excitation curves were obtained for the two lowest excited levels in ^{63}Cu and ^{65}Cu. The experimental (n,n′) cross sections for the individual levels at 668 and 961 kev in ^{63}Cu and 764 and 1114 kev in ^{65}Cu were compared to a modified Hauser-Feshbach theory for inelastic neutron scattering. The experiment confirms the spins of these levels, i.e., $^1/_2$ and $^5/_2$, respectively. (auth)

42620 (AEET/NP/8) VAN DE GRAAFF LABORATORY PROGRESS REPORT. A. S. Divatia, comp. (India. Atomic Energy Establishment, Trombay). Dec. 1963. 15p.

The operation of the Indian 5.5-Mev Van de Graaff Accelerator from April 1962 to December 1963 is summarized. Information is summarized on the following experiments conducted in the accelerator equipment: mechanism of the ^{7}Li(p,α)^{4}He reaction, ^{10}B(α,p)^{13}C reaction, energy levels of ^{27}Al from a study of proton inelastic scattering, polarization of protons in ^{12}C(p,p)^{12}C scattering, angular distribution of ^{19}F(n,α)^{16}N reaction, angular correlation studies in ^{37}Cl(p,n′γ)^{37}Ar reaction, nuclear fission studies, alpha particle scattering, and ^{3}He reactions. (N.W.R.)

42621 (AERE-R-4663) THE USE OF ^{10}B FOR NEUTRON FLUX DENSITY MEASUREMENTS, BY THE DETERMINATION OF THE ^{7}Li FORMED. N. K. Taylor and J. K. Linacre (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). July 1964. 19p.

The use of boron as a standard neutron absorber for the determination of neutron flux density could be extended to high neutron flux densities and high neutron doses (nvt) by estimation of the ^{7}Li formed. Techniques for the estimation of Li at a concentration of 10^{-8} g/ml with an accuracy of ±2% are available. Solutions of H_3BO_3, of known ^{10}B content, in heavy water, were subjected to neutron doses to give ^{7}Li concentrations of about 10^{-8} g/ml, and the thermal neutron doses were measured using ^{59}Co monitors. The cross section for ^{10}B(n,α)^{7}Li calculated from the data obtained is 775 ± 130 barns, from 61 results. Possible reasons for the poor reproducibility obtained are considered, and some proposals made for an alternative irradiation technique, which would be more widely applicable, and might give better results. (auth)

42622 (ANL-6879(p.2-20)) RESEARCH AT THE REACTOR CP-5. (Argonne National Lab., Ill.).

Low-energy neutron resonances in some eighteen nuclides ranging from Ca to Cm were studied using the fast-chopper, time-of-flight neutron spectrometer; and low-lying levels excited by the (n,γ) reaction on ^{46}Sc, ^{72}Ga, and ^{122}Sb were investigated by γ-γ coincidence measurements. The spins of nine levels in the compound nuclei formed by thermal neutron capture in ^{44}Ca, ^{54}Te, ^{58}Ni, ^{60}Ni, and ^{62}Ni were determined by gamma angular correlation measurements. The energy levels of ^{124}Te, ^{180}Hf, ^{239}U, and ^{153}Sm were studied, using a bent-crystal spectrometer to obtain the gamma spectra from thermal-neutron capture in ^{123}Te, ^{179}Hf, ^{238}U, and ^{152}Sm. Gamma angular correlations from thermal-neutron capture in ^{149}Sm and ^{113}Cd were also measured; and the level scheme of ^{150}Sm was obtained. Additionally, the gamma spectra from the capture of 0.01-ev neutrons by ^{42}Ca, ^{44}Ca, and ^{48}Ca were observed. (D.C.W.)

42623 (ANL-6879(p.21-34)) RESEARCH AT THE 4.5-Mev VAN DE GRAAFF ACCELERATOR. (Argonne National Lab., Ill.).

The differential cross sections and polarizations for neutron scattering by Cd, Mo, Nb, and Zr at 0.275 to 0.850 Mev; by Al, F, Mg, P, and Na at 0.2 to 2.2 Mev; by ^{9}Be; and by ^{6}Li and ^{7}Li at 0.1 to 2.0 Mev were measured. The data were analyzed largely by the optical model. Notably, structure was observed in neutron scattering from nuclei near A = 20; and the parities of the 7.37- and 7.54-Mev levels in ^{10}Be were determined. The neutron total cross sections of Al, Fe, and F were measured by observing simultaneously the neutron scattering and transmission by the sample. Unbound nuclear levels in the kev region in light nuclei were also studied, as well as proton reactions and scattering with ^{11}B. The differential cross sections for proton elastic scattering at 0.85 to 4.58 Mev by ^{24}Mg were measured and analyzed by dispersion theory. Additionally, the corona current was studied as a function of the voltage. (D.C.W.)

42624 (ANL-6879(p.35-63)) RESEARCH AT THE 12-Mev TANDEM VAN DE GRAAFF. (Argonne National Lab., Ill.).

An ASI-2100 computer was installed for multiparameter analysis and on-line data reduction, and equipment and techniques were developed for pulsed-beam measurements. The latter technique was used to measure the life times of excited states of ^{45}Ti, ^{48}V, and ^{43}Sc. Also, a technique was developed for mass discrimination between particles from nuclear reactions, and charged-particle reactions and scattering were studied. The magnetic spectrograph was used to investigate ^{208}Bi levels by the ^{209}Bi(d,t)^{208}Bi reaction; energy levels of odd-A W isotopes by the (d,p) reaction; deuteron reactions (d,p) on ^{182}W and deuteron elastic scattering on ^{182}W, ^{183}W, and ^{186}W; ^{3}He reactions with ^{48}Ca; and energy levels of ^{38}Ar in the ^{41}K(p,α)^{38}Ar reaction. Fluctuations in the cross section for the ^{39}K(p,α)^{36}Ar reaction were observed, and giant dipole resonances in (p,α) reactions on ^{11}B and ^{27}Al were studied. Spins were assigned for some ^{55}Fe levels, and the ^{54}Fe(d,n)^{55}Co reaction was investigated. (D.C.W.)

42625 (ANL-6879(p.65-8)) RESEARCH AT THE 60-IN. CYCLOTRON. (Argonne National Lab., Ill.).

The elastic scattering of deuterons by ^{4}He at 21 Mev was investigated, together with the ^{4}He(d,p)^{5}He reaction to the ground state. The (d,^{3}He) reaction on ^{40}Ca, ^{42}Ca, ^{43}Ca, ^{44}Ca, ^{46}Ca, ^{46}Ti, ^{47}Ti, ^{48}Ti, ^{49}Ti, ^{50}Ti, ^{89}Y, and ^{90}Zr and the (d,t) reaction on ^{42}Ca, ^{43}Ca, ^{44}Ca, ^{46}Ca, and ^{48}Ca were also measured. The reaction (d,t) on nuclei in the f-p-shell was also studied, as well as the (d,^{3}He) reaction on $f_{1/2}$ nuclei. After exposure of ^{239}Pu to a deuteron beam, a rapidly decaying spontaneous fission activity was observed. An attempt was also made to observe delayed proton emission following the positron decay of ^{17}Ne. (D.C.W.)

42626 (ANL-6879(p.69-87)) OTHER NUCLEAR EXPERIMENTS. (Argonne National Lab., Ill.).

The hyperfine structure of several nuclei was investigated; and the Mössbauer effect was observed in ^{119}Sn and ^{57}Fe metals, Mg–Sn alloy, Gd, Nb_3Sn, KI, Fe–V alloy, and Xe compounds. Also, the properties of ^{188}Re and ^{129}Xe levels were determined from observations on appropriate decay schemes; and ^{116}Sn levels populated in the decay of ^{116}Sb and ^{116}In were studied, together with ^{66}Ga levels populated by the decay of ^{66}Ge. A fission of the ^{252}Cf into three fragments was apparently observed. Further measurements were made on muonic x rays. The K x rays of Al, Mg, V, Fe, Zn, and Ni were measured with high precision, as well as the L x rays of V, Fe, Zn, Cu, and Ni. The K and L x-ray spectra of Th, ^{239}Pu, ^{235}U, and ^{238}U were obtained; similar measurements were made on Bi, Ta, and Au. (D.C.W.)

42627 (ANL-6879(p.88-113)) THEORETICAL PHYSICS. (Argonne National Lab., Ill.).

Theoretical research was continued on nuclear structure; effective nuclear interaction; stripping reactions; alpha inelastic scattering; quantum theory of relativistic scattering; and elementary particle structure, interactions, resonances, and symmetries. (D.C.W.)

42628 (CEA-R-2382) CONTRIBUTION A L'ETUDE DE LA DIFFUSION DES NEUTRONS DE 14 Mev PAR ^{12}C, A L'AIDE D'UN SPECTROMETRE A TEMPS DE VOL. (Contribution to the Study of 14-Mev Neutron Scattering by ^{12}C Using a Time-of-Flight Spectrometer). Paul Perrin (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1963. 57p.

Thesis submitted to Université, Grenoble, France.

A time-of-flight spectrometer of 1.7-nsec resolution was used to observe energy levels in ^{12}C excited by 14-Mev neutrons. (R.E.U.)

42629 (CEA-R-2407) MESURE DE LA DISTRIBUTION ANGULAIRE A 14 Mev DE NEUTRONS DE DIFFUSION INELASTIQUE SUR LE NIVEAU 0+ DE 7.65 Mev DU ^{12}C. (Measurement of the Angular Distribution of 14-Mev Neutrons Scattered Inelastically From the 0^+ Level At 7.65 Mev of ^{12}C). I. Szabo (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1964. 54p.

Thesis submitted to Universite, Grenoble, France.

Inelastic scattering of 14-Mev neutrons from ^{12}C and angular distributions for the 0^+ (7.65-Mev) level, with a time-of-flight spectrometer (over-all resolution 1.4 nsec), gives a strong forward maximum σ (θ = 15°) $\simeq$ 8 mb/sr suggesting a direct-interaction process. (auth)

42630 (COO-1120-24) ANGULAR CORRELATIONS OF GAMMA RAYS IN THE $Mg^{25}(p,\gamma)Al^{26}$ REACTION. (Kansas. Univ., Lawrence. Nuclear Physics Lab.). [1963]. Contract AT(11-1)-1120. 67p.

Angular distributions on six resonances in the $^{25}Mg(p,\gamma)^{26}Al$ reaction were measured, and the resulting gamma ray pulse height spectra were analyzed using a computer program. In addition, five triple correlation measurements were taken. The completed analysis permitted the assignments of J^π = 3+ for the 2.07-Mev (T = 0) level and J^π = 3+ for the 2.36-Mev level. Resonance levels at E_p = 956, 1652, and 1716 kev were assigned 3–, 4+ or 4–, and 4+ or 4–, respectively. A program was written for the IBM 1620 computer for fitting by the method of least squares, an experimental pulse height spectrum with a set of gamma rays of given energy. The computer determines the intensities (with standard deviations) of the set of gamma rays and calculates a goodness-of-fit parameter for selected portions of the spectrum. The computer-performed analysis suggests that statistically significant gamma rays were omitted (or simply not reported) in previous graphical decompositions of the spectra. (auth)

42631 (IAE-609) USHIRENIE I SDVID YADERBNOI LINII (LINII MESSBAVERA) V FERROMAGNETIKE. (Broadening and Shifting of the Nuclear Line (Mössbauer Line) in Ferromagnetics). Yu. Kagan and A. M. Afanas'ev (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 31p.

By means of the general diagram technique developed previously, the broadening and the shift of Mössbauer line components in ferromagnetics, connected with fluctuations of the effective magnetic field on the nuclei, are found. It is found that the non-zero broadening at $T \neq 0$ exists in all the cases due to fluctuations of the Z component of the electron spin. The broadening due to fluctuations of the X and Y components occurs only at special assumptions on system parameters. It is shown that the effects considered are essentially defined by low-frequency excitations of the electron-spin system (by the dispersion law of spin waves at small momenta). Numerical calculations were carried out to show that the width of superfine structure components can vary noticeably with temperature especially in the case of rare-earth nuclei. The mechanism of the broadening of separate superfine components due to indirect interactions between Mössbauer nuclei on account of spin waves is considered. (auth)

42632 (IAE-613) TEORIYA DIPOL'NOGO FOTOPOGLOSHCHENNIYA YADER. (Theory of Dipole Photoabsorption by Nuclei). A. B. Migdal, D. F. Zaretskii, and A. A. Lushnikov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 20p.

The gigant resonance effect, based on the Fermi-liquid theory, was investigated. Formulas were developed for the cross section of dipole photoabsorption and for absorption line intensity, and the sum rule appearing with the exchange force was developed. The mechanism of photoabsorption was discussed, and the position of the gigant resonance maximum and the spallation magnitudes in deformed nuclei were found. (tr-auth)

42633 (IFA-M-30) PROGRAMMA ISSLEDOVANII PO YADERNOI SPEKTROSKOPII S POMOSHCH'YU BETATRONA I.A.F. (The Nuclear Spectroscopy Research Program of the Institute of Atomic Physics, Carried Out by Means of a Betatron). A. I. Bedesku-Singuryanu, M. Grechesku, V. Ionesku, and Kh. Shtefan (Academia R.P.R. Institutul de Fizica Atomica, Bucharest). [1961]. 10p.

The Institute of Atomic Physics is currently carrying out a research program on photonuclear reactions and on nuclear spectroscopy, using the betatron. Several advantages are derived from such an application of the betatron: the products of the (γ,n) reaction obtained by the E_{max} = 15 to 30 Mev bremsstrahlung of the betatron could be obtained only be relatively high-energy, charged-particle reactions with a cyclotron; special attention was devoted to the study of the $^{93}Nb(\gamma,n)^{92}Nb$ reaction. For best geometry, the tests were carried out on low-activity specimens within the accelerating chamber, resulting ultimately in a 400-fold increase of the activity. The planned nuclear spectroscopic studies involve short lived isotopes, – ultimately in the $T_{1/2} = 10^{-5}$ to 1 second range. In this program the nuclide ^{180m}Ta was investigated among others. In the 20 to 210-kev region, the 26.7 ± 0.5, 57.1 ± 0.39, 95.6 ± 0.34, and 160 ± 0.79 kev γ-lines were observed, agreeing with the values reported by J. H. Carver et al. The tests also revealed the 160.5 ± 1, 331.5 ± 2, and 445.5 ± 6 kev weak γ-lines in the 100 to 545-kev range. The intensity of the γ-spectrum was found to decrease in this range with a $T_{1/2}$ = about 8 hours. (TTT)

42634 (JINR-P-1713) DVOINYE DIFFERENTSIAL'NYE RASPREDELENIYA DLYA RAZLICHNYKH YADER OT PROTONOV S ENERGIYAMI. (Double Differential Distributions of Cascade Nucleons from 660 Mev Protons Calculated for Different Nuclei). V. I. Kochkin, O. V. Lozhkin, N. S. Malytseva, Y. M. Malytsev, and Yu. P. Yakovlev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 26p.

The double differential distributions of the cascade nucleons from 660-Mev protons were calculated for different nuclei by using the intranuclear cascade model. These results can be used as starting data for computing any next cascade stage at which the fragments are produced. (auth)

42635 (JINR-P-1724) NOVYE NEITRONODEFITSITNYE IZOTOPY TSIRKONIYA. (New Neutron Deficient Isotopes of Zr). N. G. Zaitseva, V. V. Kuznetsov, M. Ya. Kuznetsova, Huo Ik Ma, G. Muziol, Shu-jun Han, Mo-lung Chou, and V. G. Chumin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 7p.

New neutron-deficient isotopes of zirconium with mass numbers 81 to 85 were found by radiochemical methods on the basis of the genetical connection with the daughter isotopes. The half lives of the light isotopes of zirconium with protons of high energy are given. (auth)

42636 (JINR-P-1727) PARAMETRY TROINOGO RASSEYANIYA PROTONOV YADRAMI UGLERODA Pri 660 Mev I SOPOSTAVLENIE REZULTATOV ANALIZA N-N I p-C RASSEYANII. (Parameters of Triple Scattering of Protons by Carbon Nuclei at 660 Mev and a Comparison of the Results of the Analysis of NN and p-C Scattering). L. S. Azhgirei, Yu. P. Kumekin, S. B. Nurushev, V. L. Solovyanov, and G. D. Stoletov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 15p.

Measurements were made of the parameters A and R in elastic scattering of 660-Mev protons by carbon nuclei at 5°. All the available data on p-C scattering at 660-Mev are used to determine the parameters of the optical potential. The results of the analysis of the data on p-C scattering at 310 and 660 Mev are compared with the results of the phase shift analysis of N-N scattering at the same energies in the framework of the superposition model. (auth)

42637 (KFKI-16/1963) THE ANGULAR DISTRIBUTION OF γ RAYS FROM THE FISSION OF U^{235}. S. Dési, G. Graff, A. Lajtai, and L. Nagy (Magyar Tudományos Akadémia Központi Fizikai Kutató Intézete, Budapest). 1963. 4p.

Measurements of the angular distribution of gamma radiation from slow neutron fission of ^{235}U are reported. Discussions of apparatus and methods used are included. (J.R.D.)

42638 (KFKI-20/1963) ON RESONANCES IN THE FORMAL THEORY OF SCATTERING. T. Dolinszky (Magyar Tudományos Akadémia Központi Fizikai Kutató Intézete, Budapest). 1963. 22p.

In established theories of reactions, the resonance structure of the scattering matrix is dealt with for interactions cut off at finite ranges. Now, using the formalism of Schwinger and Lippmann for scattering, an attempt is made to determine the poles of the scattering matrix in the case of a central one-body potential going to infinity. To this end the operand in the scattered wave is developed into the discrete Weyl series of the appropriate Coulomb-eigenfunctions. The matrix element is obtained in a dispersion structure. The resonance equations determining the poles contain as compared to the Humblet-Rosenfeld theory an additional term representing the asymptotic behavior of the potential. It is shown that the class of the "physical solutions" of the Schroedinger equation coincides with that of the resonance states. A decomposition of the stationary wave function into a compound and a direct contribution is proposed. The integral equation with built-in boundary conditions of the resonance states is given. (auth)

42639 (KFKI-1467/f) 2.6-Mev NEUTRON-INDUCED REACTIONS IN CsI. I. Borbély, T. Dolinszky, G. Hrehuss, and S. Zsoldos (Magyar Tudományos Akademia Központi Fizikai Kutató Intézete, Budapest). 1963. 5p.

The cross sections for 2.6-Mev neutron-induced reactions in CsI were investigated. Upper limits of 0.1 mb were found for the (n,p) reactions in both of the component nuclei, and 6.3 and 28.3 mb for the $^{133}Cs(n,\gamma)^{134}Cs$ and $^{127}I(n,\gamma)^{128}I$ reactions, respectively. The half life of the 137-kev (8^{-}) isomeric state of ^{134}Cs and that for the ground state β-activity of ^{128}I were measured to be 2.75 hours and 24.6 minutes, respectively. (auth)

42640 (KFKI-1467/r) ON THE ENERGIES OF THE ONE QUASI-PARTICLE EXCITATIONS IN SUPERFLUID NUCLEAR MATTER. N. Menyhárd (Magyar Tudományos Akadémia Központi Fizikai Kutató Intézete, Budapest). 1963. 12p.

The energies of one-quasiparticle states were calculated using perturbative procedures for weak-interaction nuclear theory. (R.E.U.)

42641 (KFKI-1491/G) THE EFFECT OF DEUTERON INTERNAL STRUCTURE ON THE COULOMB STRIPPING. Gy. Bencze and J. Zimanyi (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1963. 6p.

An approximate treatment of Coulomb stripping by the use of finite-range $V_{np}(r)$ potential in the neutron-proton interaction is shown. The electric polarization of the deuteron is also taken into account. The calculation shows that the corrections in proton angular distribution depend on the Q-value of the reaction. (auth)

42642 (LA-DC-6031) SPIN-ORBIT INTERACTION AND FISSION ANISOTROPY. James J. Griffin (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 6p.

Previous calculations of fission fragment anisotropies assumed an optical potential with no spin-orbit interaction. It is shown that a similar analysis including such interaction can be carried out and that the earlier results are essentially unchanged. In particular, the discrepancy between theory and experiment with regard to the effect of target spin on fragment anisotropy is not resolved by including a spin-orbit interaction. (auth)

42643 (NP-14206) MESURE DE LA CORRÉLATION ANGULAIRE (p-γ) DE LA RÉACTION $Ca^{40}(d,p)Ca^{41*}$ (1,95 Mev) EN VUE DE L'EXAMEN DE LA VALIDITÉ DE LA THÉORIE DES ONDES DÉFORMÉES. ETUDE D'UN ANALYSEUR MAGNETIQUE ET APPLICATION AUX RÉACTIONS NUCLÉAIRES (THESES). (Measurement of the (p-γ) Angular Correlation in the Reaction $Ca^{40}(d,p)Ca^{41*}$ (1.95 Mev) with the Object of Examining the Validity of the Distorted Wave Theory. Study with a Magnetic Analyzer and Application to Nuclear Reactions (thesis)). Abdo-Rahim Achari-Astani (Paris. Universite). [1962]. 107p.

The study of the p-γ angular correlation, between the proton group from the reaction $^{40}Ca(d,p)^{41}Ca$ leaving the residual nucleus in its first excited state at 1.95 Mev and the γ de-excitation radiation of this level, was undertaken in order to examine the validity of the deformed wave theory proposed by Huby and his collaborators. A target of natural Ca was bombarded by a beam of 6.6-Mev deuterons, and two scintillators were used as detectors. The p-γ coincidence was measured by conventional slow-fast coincidence methods and a time-amplitude converter method. The angular correlation was measured in two perpendicular planes, and the results were analyzed by the least squares method. The perfect agreement between the theoretical and experimental value of A_2^0 and the verification of the inequality $\lambda < 1$ favors the theory of deformed waves. However it appeared that the formalism was incapable of explaining the ensemble of correlation and polarization phenomena. A magnetic spectrometer with 180° sector angle and 0.57 index was studied and perfected. The angular distribution of the proton group from the reaction $^{40}Ca(d,p)^{41*}Ca$ was measured and the results were analyzed by the simple stripping theory. They confirmed the value of $l = 1$ for the angular moment of the captured neutron and $r_0 = 5.6$ fermi for ^{40}Ca. (J.S.R.)

42644 (NP-14329) DOPPEL- UND TRIPEL-KORRELATIONSMESSUNGEN AN EINER GAMMAKASKADE BEI $Al^{27}(p,\gamma)Si^{28}$. (Double and Triple Correlation Measurements at the $Al^{27}(p,\gamma)Si^{28}$ Gamma Cascade (thesis)). Joerg W. Mueller (Zurich. Universitat). 1963. 100p.

In the reaction $^{27}Al(p,\gamma)^{28}Si$, a gamma cascade occurring at the well-known resonance for $E_p = 992$ kev was carefully investigated. This main decay mode of the level leads through the first excited state at 1.77 Mev to the ground state of ^{28}Si. Double correlations of the single gamma rays as well as triple correlations in two different geometries were performed, adapting the sum-coincidence method for angular distribution measurements. Comparison of the experimentally determined Legendre coefficients with those computed theoretically allows an unambiguous determination 3^+ for spin and parity of the resonance level at 12.536 Mev, in agreement with previous supposition. The mixing ratio amplitude of d to s protons can be determined to be -0.11 ± 0.02 (Coulomb phase shift taken into account). This result compares favorably with the absolute value 0.127 ± 0.002 computed from the relative proton penetrabilities. For the channel spin mixing ratio only a lower limit can be determined ($t \gtrsim 0.25$), which permits the exclusion of two of the four simplest LS-configurations for the resonance level but is in agreement with both t values computed for pure jj-coupling. Whereas the first gamma ray ($3^+ \rightarrow 2^+$) has an experimental E2/M1 mixing parameter -0.09 ± 0.03, the second is a pure E2 transition ($2^+ \rightarrow 0^+$). Using the single particle model we would get (with $r_0 = 1.2$ f) a value of about $|x_1| = 0.15$. Since, however, the Weisskopf estimate for the branching ratio of E2/M1 transitions is empirically known to be too small by about an order of magnitude on the average, a comparison with the measured value x_1 shows that no isotopic spin selection rule is effective, as would be expected for dipole transitions with $\Delta T = 0$ in self-conjugate nuclei. Therefore a tentative assignment of $T = 1$ is made to the resonance state. (auth)

42645 (NP-14338) RESIDUAL FORCES IN SINGLE-PARTICLE MODELS. R. A. Sorensen (Buenos Aires. Universidad. Facultad de Ciencias Exactas, Fisicas y Naturales). July 1961. 68p.

Single-particle aspects of the shell model are discussed. The collective model is derived from the spherical shell model by allowing the independent particles to interact. (R.E.U.)

42646 (ORNL-TM-954) SOME RECENT NUCLEAR CROSS SECTION MEASUREMENTS AT ORNL, JUNE 2–OCTOBER 1, 1964. P. H. Stelson (Oak Ridge National Lab., Tenn.). Sept. 23, 1964. Contract [W-7405-eng-26]. 22p.

Progress is reported on a neutron-capture cross section detector, measurement of capture-to-fission ratios at 3.25 ev to 1.8 kev, measurement of neutron resonance parameters for hafnium isotopes, measurements of the gamma spectra from thermal-neutron capture by bismuth and ^{238}U, and fission fragment measurements for ^{252}Cf using solid-state detectors. (R.E.U.)

42647 (PAN-508/VII) ODDZIALYWANIE WZBUDZEN OSCYLACYJNYCH Z OBROTEM JADRA. (Vibration-Rotation Interaction in Deformed Nuclei). Adam Sobiczewski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Apr. 1964. 52p.

The correction to the energy of the ground state rotational band levels of even nuclei, due to the interaction between these levels and the lowest gamma type (K = 2) and beta type (K = 0) vibrations, was obtained. The corresponding numerical calculations, based on a realistic nuclear model, were performed for several nuclei of the rare-earth region. The results were compared with experimental estimates obtained from the measurements of the decay branching ratios. (auth)

42648 (RTD-TDR-63-4086) RADIOACTIVE DECAY OF KRYPTON-79. Paul Polishuk and Henry P. Kalapaca (Research and Technology Div. Air Force Materials Lab., Wright-Patterson AFB, Ohio). Oct. 2, 1963. 67p. (AD-432265)

The decay of ^{79}Kr was studied using various gamma spectroscopy techniques. Besides new results on the decay of ^{79}Kr, a detailed procedure is presented for setting up, checking out, and operating a fast-slow coincidence circuit and other auxiliary equipment required in this research. Results of this study indicate that the decay scheme, proposed by Thulin, et al., requires revision; revision to the decay scheme is proposed. (auth)

42649 (TID-7050(p.24-89)) CALCULATION OF NUCLEAR CROSS SECTIONS. N. C. Francis, D. T. Goldman, and C. R. Lubitz (Knolls Atomic Power Lab., Schenectady, N. Y.).

Methods used to calculate nuclear reaction cross sections of interest in reactor physics are described. Algebraic equations, basic models, and computer programs are considered. (R.E.U.)

42650 (TID-21144) HIGH-RESOLUTION NEUTRON SPECTROSCOPY IN THE Kev REGION: Al, Ti, Fe, Ni, Cu, Zn, V, Mn, Co AND Bi. J. B. Garg, J. Rainwater, and W. W.

Havens, Jr. (Columbia Univ., New York. Pegram Nuclear Physics Labs.). [1964]. Contract AT-30-1-GEN-72. 77p. (EANDC(US)-54(L); CR-1860)

Total cross section measurements were made from 200 ev to about 200 kev on Al, Ti, Fe, Ni, Cu, Zn, V, Mn, Co, and Bi. The resonance level energies were determined for each of these nuclei. Isotopic assignments of some of the resonances whose neutron widths are larger than the resolution width were made by comparing the observed peak cross section with the expected theoretical values for pure scattering. In some favorable cases, spin assignments of levels were also made. The combined level spacing distributions of all zero-spin nuclei as well as non-zero-spin nuclei were compared with the theoretical distributions of real symmetric hamiltonian matrices with randomly distributed matrix elements and with random distributions. The experimental data seems to favor the former, showing the level repulsion effect. The values of the coefficient of correlation between adjacent spacings were determined for each of these nuclei, and the results, although showing a slightly stronger correlation than predicted by theory, are not inconsistent with the theoretical value within the uncertainty of the measurements. (auth)

42651 (UCRL-7553-T) MULTIPION RESONANCES AND THE NUCLEAR FORCE PROBLEM. Malcolm H. MacGregor (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 22, 1963. Contract W-7405-eng-48. 10p.

The contributions of multipion resonances in intermediate-range nuclear forces, which are due to the exchange of a small number of pions, are discussed. Pole contributions to phase shifts in nucleon-nucleon interactions near 140 Mev were investigated. It is argued that the multipion resonances do not dominate the two- and three-pion contributions, and that any accurate calculation of the nuclear force will have to be a full-blown dispersion calculation including non-resonating as well as resonating multipion contributions. (R.E.U.)

42652 (ANL-Trans-68) QUASI-CLASSICAL MODEL OF TRIPLE FISSION. B. T. Geilikman (Geylikman) and G. I. Khlebnikov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii. Institut Atomnoi Energii im. I. V. Kurchatova, Moscow). Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from p.3-9 of IAE-562, Moscow, 1964. 11p.

The classical model of triple fission with departure of α particles, which considers the distribution of α particles over energies in the fissioning nucleus, was studied. The energies and angular distributions of the departing α particles were calculated. The theoretical distributions agree satisfactorily with the experimental data. (auth)

42653 DIRECT INTERACTIONS IN THE NUCLEAR SURFACE. N. C. Francis, D. T. Goldman, and C. R. Lubitz (Knolls Atomic Power Lab., Schenectady, N. Y.). Ann. Phys. (N. Y.), 29: 232-58(Sept. 1964). (TID-20088)

A model is described for the calculation of direct reactions in the nuclear surface. Pair collisions are assumed to occur as though the two nucleons were free, with a relative energy depending on the kinetic energy of the incident particle, the binding energy of the struck particle, and the Coulomb energy of the center of mass of the pair. The model is investigated via a square-well, two-body scattering matrix and an approximate variational procedure. Applications to low-energy nuclear reactions are discussed. (auth)

42654 MUON SCATTERING. S. Ghosh and B. K. Bandyopadhyay (Presidency Coll., Calcutta). Ann. Physik (7), 13: 325-9(1964).

The scattering of mesons (μ) in copper and lead at 1.658 ± 0.05 Bev/c was studied, using a multiplate cloud chamber. The observed distributions were analyzed by the theories of Moliere and of Cooper and Rainwater. (D.C.W.)

42655 SOME REACTIONS IN ZINC PRODUCED BY 30-Mev PROTONS. T. N. Mikhaleva. At. Energ. (USSR), 17: 142-4(Aug. 1964). (In Russian)

A natural mixture of Zn isotopes was irradiated with protons of energy about 30 Mev. Nickel and cobalt formed in the reactions were separated chemically. Decay curves and gamma intensities of the Co and Ni isotopes are given. (M.J.T.)

42656 ENERGY LEVELS IN A BOUNDED ISOTROPIC HARMONIC OSCILLATOR POTENTIAL AND NUCLEAR SHELL STRUCTURE. S. Sengupta and S. Ghosh (Darjeeling Government Coll., India). Indian J. Theoret. Phys., 6: 1-21(Mar. 1958).

The quantum mechanical problem of a nucleon moving within an isotropic harmonic oscillator potential of value $V = \frac{1}{2} kr^2$, and enclosed within a spherical box with rigid walls (infinite potential well) is investigated. Approximate expressions for energy levels are obtained. These levels are essentially determined by the parameter $\rho = \hbar\omega/(\hbar^2/MR^2)$ where $\omega = \sqrt{k/M}$ is the classical circular frequency of the oscillator and R is the radius of the box. For small ρ energy levels tend to those of infinite potential well and for large ρ they tend to the energy levels of an unbounded oscillator. Introducing a spin orbit coupling term 30 times Thomas value and for $\rho = 6$ and $R = 1.3 \times 10^{-13} A^{1/3}$ excellent agreement with experimental shell structure is obtained. Level schemes are in close agreement with the observed ones. (auth)

42657 ON FERMI THEORY AND SARGENT RULE FOR β DECAY. Sabita Purkayastha (Inst. of Theoretical Physics, Calcutta). Indian J. Theoret. Phys., 6: 23-34 (Mar. 1958).

In this paper Sargent's rule was studied from the standpoint of Fermi's theory. A number of theoretical Sargent curves were drawn with different constants according to Fermi's formula. The experimental points are found to lie on these curves even in the bent portion at low energy region irrespective of the atomic number Z and ΔI. (auth)

42658 THEORY OF ALPHA DISINTEGRATION. K. C. Kar and A. K. Bhattacharyya (Inst. of Theoretical Physics, Calcutta). Indian J. Theoret. Phys., 8: 47-83(June-Sept. 1960).

Kar and Kundu theory was extended by introducing for the first time the idea of probability of formation of the alpha particle within the nucleus. A more or less complete explanation of non-fine structure and fine structure in spontaneous alpha disintegration was given. (auth)

42659 FISSION SPECTRUM AVERAGED CROSS SECTIONS OF THRESHOLD REACTIONS. J. W. Boldeman (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). J. Nucl. Energy, Pts. A & B, 18: 417-24(Aug. 1964). (AAEC/TM-237)

The average cross sections for several (n,α) and (n,p) reactions were measured in a ^{235}U fission neutron spectrum that was obtained from a neutron convertor. The results were compared with values obtained elsewhere. (D.C.W.)

42660 PHOTONEUTRONS FROM ^{93}Nb. K. Schluepmann and R. Wendling (Universität, Heidelberg). Naturwissenschaften, 51: 380(1964). (In German)

The energy distribution of photoprotons from bremsstrahlung reactions with ^{93}Nb at 32 ± 1 Mev was investigated. The protons were detected with a CsI(Tl) scintillation spectrometer. Results are shown in a graph. The maximum number of protons were observed with an energy of 6 Mev. The total number of registered protons amounted to 12,800. (M.C.G.)

42661 INTERPOLATED ENERGY DISTRIBUTIONS OF Cs^{137} GAMMA RAYS SCATTERED IN WATER. A. Scharschmidt (Johann-Wolfgang-Goethe Universität, Frankfurt am Main). Nucl. Instr. Methods, 27: 311-15(July 1964).

Using the moment-method spectra of Goldstein and Wilkins complete energy distributions of the number flux of multiply scattered γ rays in water, starting from a point isotropic source of ^{137}Cs, were evaluated by interpolation for $\mu_0 r = 1 \ldots 20$. The corresponding energy build-up factors are given. The recent experimental work of Sybesma is also discussed. (auth)

42662 A METHOD FOR THE DETERMINATION OF THE THICKNESS OF THIN Li-TARGETS. S. Schwartz and L. G. Stroemberg (Research Inst. of National Defence, Stockholm). Nucl. Instr. Methods, 27: 332-4(July 1964).

The time-of-flight spectrum from the ^{7}Li(p,n)^{7}Be reaction for proton energies close to the neutron threshold was used for determination of target thickness. A ^{6}Li-glass scintillator was used as a neutron detector. The accuracy was of the order of 0.1 kev for target thicknesses of a few kev. (auth)

42663 ANALYSIS OF NUCLEAR DECAY DATA FOR LIFETIMES OF 10^{-9} SEC ORDER. I. Berkes, I. Dézsi, Ilona Fodor, L. Keszthelyi, and Vera Korbuly (Central Research Inst. for Physics, Budapest). Nucl. Instr. Methods, 27: 355-6(July 1964).

The determination of nuclear lifetimes of the order of coincidence resolution time, or less, can be performed by moment methods. To gain more information from the delayed coincidence curve it was found necessary to make an assumption on the analytic form of the prompt (resolution) curve. It was taken to be a Gaussian and the validity of this assumption was checked for the second excited state of ^{26}Al and for the first excited state of ^{25}Al. (M.C.G.)

42664 PROTON–ARGON ELASTIC SCATTERING AT 9.8 Mev. T. Hon Jeong, L. Johnston, S. Suwa, and H. B. Chiang (Univ. of Minnesota, Minneapolis). Nucl. Instr. Methods, 28: 325-9(Aug. 1964).

The differential cross section for proton elastic scattering by argon at 9.805 Mev was measured at laboratory angles of 2 to 40°. The probable errors in the absolute cross sections varied from ±1 to 2.5%. The final values were obtained by extrapolation of the measured cross sections against target pressures and the thickness of the entrance foil of the scattering chamber. (D.C.W.)

42665 MULTIPOLARITIES OF TRANSITIONS IN THE DECAY OF Au^{194} TO Pt^{194}. O. Bergman and G. Baeckstroem (Inst. of Physics, Uppsala). Nucl. Phys., 55: 529-58(July 1964).

Gamma ray intensities have been determined by photoelectron measurements using a 50 cm radius double focusing spectrometer. Internal conversion intensities have also been measured accurately for some basic transitions in this decay. Conversion coefficients were obtained by normalizing the ratios of conversion and photon intensities with respect to the E2 transition from the first excited state. Multipolarity information has thus been obtained for 79 transitions. Evidence for six E0 transitions was found. The log ft values of the electron capture branches were calculated from the transition intensities. Spin assignments have been made for many of the known levels. The majority of the levels have been found to be of even parity, although the beta decay would preferentially select odd parity states. This result may be understood in terms of current nuclear models. A few modifications of the previously reported scheme of levels are proposed on the basis of a computer analysis of the transition energies. The most important alteration is the addition of a level at 811 kev. The results are discussed from the point of view of systematics and of gamma ray selection rules. (auth)

42666 GAMMA-RAY BRANCHINGS IN ^{34}Cl FROM THE ^{33}S(p,^{34}Cl γ) REACTION. P. W. M. Glaudemans, L. Eriksson, and J. A. R. Werkhoven (Rijksuniversiteit, Utrecht). Nucl. Phys., 55: 559-76(July 1964).

The gamma-ray yield from the reaction ^{32}S(p,γ)^{34}Cl was measured in the range E_p = 300 to 1300 kev. Twenty-two resonances were observed with resonance strengths $(2J_r + 1)\Gamma_p\Gamma_\gamma/\Gamma$ between 0.01 and 1.0 ev. From single and coincidence spectra with scintillation spectrometers the gamma-ray branchings of the resonance levels and of nineteen lower levels in ^{34}Cl were obtained. The decay of the levels of ^{34}Cl below 2.5 Mev is compared with spin predictions from the shell model. (auth)

42667 ELECTRON CAPTURE IN Tl^{204}. P. Christmas (National Physical Lab., Teddington, Middx., Eng.). Nucl. Phys., 55: 577-92(July 1964).

Electron capture in ^{204}Tl was studied by observing x rays emitted by the daughter nucleus ^{204}Hg. Two similar NaI scintillation detectors were used, each of geometrical efficiency close to 50%. From measurements of coincidences between K and L x rays, the L/K capture ratio was determined to be 0.60 ± 0.055. The K capture/β^- ratio was deduced from absolute counting of K x rays and β-particles; the value obtained was 0.0159 ± 0.00036. From this value, and that obtained for the L/K ratio, the electron capture branching ratio was determined to be 0.0254 ± 0.0012. (auth)

42668 ANGULAR CORRELATIONS AND NUCLEAR POLARIZATION FROM THE INELASTIC SCATTERING OF ALPHA PARTICLES. J. G. Cramer, Jr. and W. W. Eidson (Indiana Univ., Bloomington). Nucl. Phys., 55: 593-612(July 1964).

When alpha particles are inelastically scattered from an even nucleus, all particles in the interaction except the excited nucleus are spinless, with the results that the angular momentum relationships of the interaction are greatly simplified and the polarization of the excited nucleus and the angular distribution of the decay radiation from this nucleus are related in a straight-forward manner. For this situation, the functional dependence of the angular correlation between the decay radiation and the scattered alpha particle is calculated in terms of parameters describing the polarization of the excited nucleus, assuming either gamma-ray or alpha-particle decay of this nucleus. The angular dependence of the gamma-ray circular polarization is also calculated and related to the nuclear polarization. Experiments are outlined for measuring nuclear polarization with particle-gamma or particle-particle correlation studies, and the kinematical problems inherent in the latter are discussed. (auth)

42669 ANGULAR CORRELATION STUDIES OF NUCLEAR POLARIZATION FOLLOWING INELASTIC SCATTERING OF ALPHA PARTICLES FROM C^{12} AND Mg^{24}. W. W. Eidson, J. G. Cramer, Jr., D. E. Blatchley, and R. D. Bent (Indiana Univ., Bloomington). Nucl. Phys., 55: 613-42(July 1964).

Alpha-gamma angular correlations have been measured at 73 scattering angles in the reaction plane for the reaction $^{12}C(\alpha,\alpha'\gamma_{4.43})$ and at 40 scattering angles for the reaction $^{24}Mg(\alpha,\alpha'\gamma_{1.37})$. The correlation functions were determined at each alpha-particle scattering angle by measuring the coincidence gamma ray yield for at least 11 different gamma detection angles. All of the particles in both reactions (except the excited nuclei and the gamma rays) are spinless, greatly simplifying interpretation of the correlation data. These data have been analyzed in terms of the polarization of the excited nucleus, and show the presence of curious and distinctive behavior in the functional dependence of the polarization parameters on scattering angle for both reactions studied. These results are compared with the predictions of reaction theories, and show strong disagreement with semi-classical, plane-wave, and adiabatic theory predictions, while giving at least qualitative agreement with DWBA calculations. Predictions of compound nucleus theory are investigated, and the relevance of this type of measurement to the investigation of reaction mechanisms and their interference effects is discussed. (auth)

42670 THE DISINTEGRATION OF Ar^{36} AND Ar^{40} BY NEUTRONS. E. A. Davis, T. W. Bonner, D. M. Worley, Jr., and R. Bass (Rice Univ., Houston, Tex.). Nucl. Phys., 55: 643-56(July 1964). (TID-20268)

A grid-type ionization chamber filled with argon or an argon–carbon dioxide mixture has been used to measure cross sections for the (n,α) and (n,p) reactions in ^{36}Ar and the (n,α) reaction in ^{40}Ar induced by monoenergetic neutrons with energies between 1.2 and 9 Mev. For reactions in ^{36}Ar, groups of alpha particles were observed leaving ^{33}S in its ground and first seven excited states, and groups of protons leaving ^{36}Cl in its ground and first five excited states. The total cross section for these alpha groups increased from 2 mb at 1.2 Mev to about 160 mb at 4 Mev and then decreased to 61 mb at 8.7 Mev. The total cross section for the observed proton groups varied from 13 mb at 1.2 Mev to 290 mb at 4.7 Mev. For reactions in ^{40}Ar groups of alpha particles were observed leaving ^{37}S in its ground state and excited states at 0.65 ± 0.06, 1.39 ± 0.07, and 2.19 ± 0.09 Mev. The total cross section for these groups varied from 0.1 mb at 6 Mev to about 3 mb at 9 Mev. The relative magnitudes of the cross sections for the (n,p) and (n,α) reactions are compared with the predictions of simple nuclear reaction theory. (auth)

42671 A RE-INVESTIGATION OF THE DECAY OF Eu^{147} TO Sm^{147}. J. F. McNulty, E. G. Funk, Jr., and J. W. Mihelich (Univ. of Notre Dame, Ind.). Nucl. Phys., 55: 657-68(July 1964). (TID-20276)

A re-investigation of the decay of ^{147}Eu has been undertaken; gamma-ray intensity measurements and gamma-gamma directional correlations have been performed using an isotopically and chemically pure source. Gamma-gamma directional correlations were measured for the 680-122 and 957-122 kev cascades; the data were consistent with the predominantly MI assignment for the 680 kev transition based on internal conversion data. Evidence has been found for gamma transitions with energies of 1122, 1195, 1250, 1320, 1326, 1423, and 1448 kev. Gamma-gamma coincidence measurements performed on a chemically but not isotopically pure source of ^{147}Eu showed that the 1122 and 1250 kev transitions are in coincidence with the 198 kev transition and that the 1195, 1326, and 1423 kev transitions are in coincidence with the 122 kev transition. The energy of the "881 kev" transition was measured and found to be 862 kev. This transition is shown to proceed from a level of 1060 kev; internal conversion coefficient data and gamma-gamma directional correlations indicate that the spin and parity of this level would be $^3\!/_2{}^+$ assuming a spin sequence for the three lowest levels of $^7\!/_2{}^-$, $^5\!/_2{}^-$, and $^3\!/_2{}^-$. The total position feeding was determined to be (0.54 ± 0.08)% of the total decay. The experimental results are compared with the theoretical results obtained by employing quasi-particle states to account for the short-range forces and zero, one, and two phonon states for the collective effects. (auth)

42672 A SEARCH FOR AN INTERMEDIATE LEVEL IN Ag^{110m}. M. Pasternak and E. Nardi (Israel Atomic Energy Commission, Rehovoth). Nucl. Phys., 55: 669-72(July 1964).

A search was conducted for a low-level gamma ray following the 0.116-Mev transition of 253-d ^{110m}Ag. The experiment was performed by looking for gamma rays in coincidence with the K x rays of the totally converted 0.116-Mev level. Except for ^{110}Cd K x rays, no coincident radiation was found in the $^{110m}Ag \rightarrow {}^{110}Ag$ decay.

42673 THE CALCULATION OF NEUTRON CROSS-SECTIONS FROM OPTICAL POTENTIALS. D. Wilmore (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and P. E. Hodgson. Nucl. Phys., 55: 673-94(July 1964).

Neutron total and differential elastic scattering cross sections for Si, S, Ca, Ti, Fe, Ba, Pb, and U are calculated from generalized optical potentials and compared with experimental data. The potentials used are a local potential equivalent to a particular non-local potential, and a neutron potential corresponding to a particular proton potential. In the former case satisfactory agreement with experiment is obtained. Simple formulae for optical potentials are given as a function of energy and mass number, from which neutron cross sections can be calculated from 1 to 15 Mev for medium and heavy nuclei. (auth)

42674 PROPERTIES OF NUCLEAR LEVELS IN A NUMBER OF EVEN-MASS NUCLEI ($184 \leqq A \leqq 192$). B. Harmatz and T. H. Handley (Oak Ridge National Lab., Tenn.). Nucl. Phys., 56: 1-45(July 1964).

A large accumulation of internal conversion-electron data has made it possible to study the properties of high-energy nuclear levels in the transition region of mass numbers 184 to 192. Reasonably detailed level schemes have been constructed from these measurements, leading to the following even nuclei: $^{184m}Re \rightarrow {}^{184}W$, $^{186}Ir \rightarrow {}^{186}Os$, $^{188}Ir \rightarrow {}^{188}Os$, $^{190}Ir \rightarrow {}^{190}Os$, and $^{192}Ir \rightarrow {}^{192}Os$. Parameters relevant to rotational configurations and branching ratios of the de-exciting transitions are evaluated. The low-energy spectra, with their associated vibrational and rotational modes of excitation, have been extended. Triple isomerism was observed in ^{190}Ir including isomeric transitions of M3 (26 kev) and M4 (148 kev) character. The metastable state of ^{184}Re is partially de-excited by an 83-kev isomeric transition of M4 multipolarity. (auth)

42675 SMALL-ANGLE SCATTERING OF 143 Mev POLARIZED PROTONS. D. J. Steinberg (Harvard Univ., Cambridge, Mass.), J. N. Palmieri, and A. M. Cormack. Nucl. Phys., 56: 46-64(July 1964).

The polarization and differential cross section have been measured for the scattering of 143 Mev protons in the angular range of 2 to 11° by beryllium, carbon, aluminum, iron, and tantalum. A four-counter telescope was used which had an angular resolution of less than 0.5° and an energy resolution of about 2.7%. Background and random coincidences were virtually eliminated. The angular divergence of the proton beam was 0.25°, and its polarization was 68%. Careful alignment of the apparatus and continual monitoring of the incident beam position permitted the relative polarizations to be determined to ±0.01. The cross sections were measured with a relative error of about 0.7% and an absolute error of 3%, exclusive of effects arising from multiple scattering. The polarizations at the smallest angles are negative for each of the scatterers. (auth)

42676 g-FACTOR MEASUREMENT OF THE 133 kev LEVEL IN ^{131}Cs. D. E. Brandão, H. J. Koerner, Alice Maciel, C. S. Mueller, and F. C. Zawislak (Universidade do Rio Grande do Sul, Pôrto Alegre, Brazil). Nucl. Phys., 56: 65-72(July 1964).

The g factor of the 133-kev level in ^{131}Cs has been measured by the differential angular correlation method with an external magnetic field. The result obtained is g = +0.99 ± 0.06. (auth)

42677 ANGULAR DISTRIBUTIONS OF PHOTONUCLEONS ABOVE THE GIANT RESONANCE REGION. Saburo Fujii (Univ. of Virginia, Charlottesville) and Osamu Sugimoto. Nucl. Phys., 56: 73-85(July 1964).

The (γ,n) and (γ,p) angular distributions in the energy region above the giant resonance are calculated for ^{16}O. Descriptions of the photonuclear process with correlations between nucleons in the nucleus as well as the direct process are considered. In particular, a connection between the angular distributions and the E1 and E2 giant resonances is investigated in detail, though the fine structure of those resonances is neglected. The result is compared with experimental data. The existence of an E1 resonance closely connected with an experiment on the inelastic scattering of electrons is also discussed. (auth)

42678 TWO-PROTON RADIOACTIVITY THEORY. V. M. Galitsky and V. F. Cheltsov (Physical Engineering Inst., Moscow). Nucl. Phys., 56: 86-96(July 1964).

A method of studying two-proton radioactivity is offered. The method is based on the similarity of the problem with nucleon pairing in spherically symmetrical nuclei. The method is applied to the case when the quasi-stationary one-proton level has no orbital angular momentum. The total probability of the decay per unit time and the distribution of the emitted protons in directions and relative energies are obtained. (auth)

42679 INVESTIGATION OF THE (d,p) REACTION ON MAGNESIUM ISOTOPES AT LOW DEUTERON ENERGIES. H. M. Omar, I. I. Zaloubovski, M. H. S. Bakr, R. Zaghloul, and V. J. Gontchar (Atomic Energy Establishment, Cairo). Nucl. Phys., 56: 97-112(July 1964).

Spectra of protons emitted from the reactions ^{24}Mg(d,p)-^{25}Mg and ^{26}Mg(d,p)^{27}Mg at 8 angles and at 29 deuteron energies from 1.2 to 2.5 Mev have been measured. A rotating target chamber and thin metal targets of the separated isotope ^{26}Mg as well as natural magnesium targets have been used. Proton spectra were detected by an n-Si semiconductor detector with 3600 Ω · cm specific resistance, linear up to E_p = 8 Mev. The resolving power of the semi-conductor for ^{210}Po α particles was about 1%. Angular distributions of p_0, p_1, p_2, p_3, p_4, and $p_{8,9}$ groups for the first reaction, and p_0, p_1, and P_{5-8} for the second, were obtained in a wide deuteron energy range. Total cross sections as a function of the deuteron energy have been measured. Angular distributions of certain proton groups have a typical stripping pattern. The presence of two prominent resonances in the total cross section, as well as a strong dependence of the shape of angular distributions on the deuteron energy, points to the importance of interference between stripping and compound nucleus formation. (auth)

42680 THE ENERGY SPECTRA OF α-PARTICLES IN NUCLEAR PHOTO PROCESSES ON Ti, Ni, Cu, AND Nb. J. A. Scheer, K. Schluepmann, and F. Triantafyllidis (Universität, Heidelberg). Nucl. Phys., 56: 113-16(July 1964). (In German)

The energy spectra of photoproduced alpha particles were measured with 32.5-Mev bremsstrahlung from the Heidelberg betatron using a totally depleted solid state detector of 90 μm thickness. Alpha particles between 4 and 12.6 Mev could be detected. Yield values in μb/Mev were found to be 22, 45, 23, and 5.5 for Ti, Ni, Cu, and Nb respectively. (auth)

42681 A SEARCH FOR AN EXCITED STATE OF B^9 NEAR 1.7 Mev. R. W. Bauer, J. D. Anderson, and C. Wong (Univ. of California, Livermore). Nucl. Phys., 56: 117-28 (July 1964). (UCRL-7538)

In a search for low-lying excited states of ^{9}B, the alpha-particle spectra from the ^{12}C(p,α) reaction were investigated for laboratory angles from 22 to 120° at bombarding energies from 12.7 to 18.3 Mev. Also, the neutron spectra from the ^{9}Be(p,n) reaction at proton energies of 6.3 and 7.4 Mev, and from the ^{6}Li(α,n) reaction at an alpha energy of 14.4 Mev, were measured over similar angular ranges. The three reactions produced no systematic evidence for excited states in ^{9}B between 0.5 and 2.0 Mev excitation. Results do not confirm a previously reported 1.7-Mev excited state in ^{9}B; an upper limit for the excitation of this level by the three reactions can be set at about 100 μb/sr. The accuracy of this result is limited because of the multibody breakup processes (mainly four-body breakup) competing with the reactions under study. Cross sections for these multibody reactions are presented. Evidence is also presented for the two-body decay of the 9.6-Mev level in ^{12}C and the 3.1-Mev level in ^{9}Be. (auth)

42682 LEVEL SCHEME OF I^{129}. A. V. Ramayya, Y. Yoshizawa, and Allan C. G. Mitchell (Indiana Univ., Bloomington). Nucl. Phys., 56: 129-39(July 1964).

The decay of 33 d ^{129m}Te has been studied by means of beta-gamma and gamma-gamma coincidence and sum-peak techniques. The gamma rays were found to depopulate at the levels 27, 280, 492, 570, 710, 840, 1045, 1127, 1255, and 1400 kev. The analysis of the coincidence spectra suggests that the 210, 280, and 820 kev gamma rays are each composed of two transitions of nearly the same energies. From the gamma-ray intensities and the beta-gamma coincidence spectra, the beta-ray feedings and the log ft values are calculated. (auth)

42683 THE RADIOACTIVE DECAY OF Ag^{111}. V. V. G. Sastry, V. Lakshminarayana, and Swami Jnanananda (Andhra Univ., Waltair, India). Nucl. Phys., 56: 140-6(July 1964).

The decay of ^{111}Ag is studied, employing a 4π sum peak coincidence spectrometer. It is observed that the beta decay of ^{111}Ag leads to an excited state at 610 kev, in addition to levels at 340 and 247 kev. The beta branch feeding the 610 kev level is estimated to be 0.5 ± 0.05%. The relative *intensities of gamma transitions involved are measured.* The decay scheme of ^{111}Ag is presented. (auth)

42684 *THE DECAY $Ta^{182} \rightarrow W^{182}$. H. Daniel* (Max-Planck-Institut für Kernphysik, Heidelberg), J. Huefner, Th. Lorenz, O. W. B. Schult, and U. Gruber. Nucl. Phys., 56: 147-60(July 1964). (In German)

The decay $^{182}Ta \rightarrow {}^{182}W$ has been investigated with a double-focussing β-ray spectrometer and a curved crystal γ-ray spectrometer. The β spectrum consists of six components: 257 kev (log ft = 7.3), 437 kev (8.3), 479 kev (9.2), 521 kev (8.3), 553 kev (9.4), and 1482 kev (12.2). The measured conversion coefficients agree with theoretical values. In particular, the previously reported conversion anomaly of the 152.4-kev transition has not been confirmed. By means of β-γ coincidence experiments the Q value of the ^{182}Ta decay was found to be Q = (1.811 ± 0.007) Mev. The results can well be interpreted in terms of collective models. The γ-ray intensities of $^{183}Ta \rightarrow {}^{183}W$ have also been measured. (auth)

42685 INVESTIGATION OF SOME LONG-RANGE FORCE CORRECTIONS TO THE GROUND-STATE ENERGY OF NUCLEAR MATTER. T. Dahlblom, K.-G. Fogel, B. Qvist, and A. Toern. Nucl. Phys., 56: 177-90 *(July 1964).*

Some long-range corrections to the ground-state binding energy in nuclear matter are calculated according to Moszkowski-Scott variant of Brueckner's method. The second-order Born term $v_1(Q/e)v_1$ including exchange is *calculated. The long-range potential (v_1) used is the OPEP* with a varied cut-off distance. Kinetic energies with an effective mass $M^* = 0.75\ M$ are used for the single-particle states. The results from the calculation of the correction terms in third and fourth order seem to indicate that the long-range effects do not endanger the cluster expansion. For a typical value of the cut-off distance (1 fm) the energy arising from the exchange part of $v_1(Q/e)v_1$ turns out to be -2.3 Mev, a value which is not negligible compared with the direct contribution - 10 Mev. (auth)

42686 BINDING ENERGY OF NUCLEAR MATTER. G. E. Brown (Massachusetts Inst. of Tech., Cambridge), G. T. Schappert, and C. W. Wong. Nucl. Phys., 56: 191-212(July 1964).

Various calculations of the binding energy of nuclear matter are discussed. The question of off-the-energy shell propagation is considered in detail. Numerical approximations made in the calculations are investigated, and it *is shown that they are such as to give too much binding* energy, so that the present discrepancy between theoretical and experimental values is worsened. (auth)

42687 EFFECT OF SHORT-RANGE REPULSION IN NUCLEAR MATTER. Chun Wa Wong (Harvard Univ., Cambridge, *Mass.; Univ. of Minnesota, Minneapolis;* and Universitet, Copenhagen). Nucl. Phys., 56: 213-23(July 1964).

The binding energy in nuclear matter was calculated for two S-wave potentials (one with a hard core and the other with a Yukawa repulsive core) by the reference-spectrum method of the Brueckner-Bethe-Goldstone theory of nuclear matter. Pauli and spectral correction terms are included, and single-particle potentials are calculated self-consistently up to as high as 5 to 6 fm^{-1}. The improved treatment of off-energy-shell effects causes a displacement of the saturation curve (i.e., total energy versus density) in the direction of decreased equilibrium density and decreased binding energy per particle. The use of a finite repulsive core increases the equilibrium binding energy per particle by 4 to 7 Mev and also significantly increases the equilibrium density. This indicates that phenomenolog*ical nucleon-nucleon potentials with finite repulsive cores* should yield more satisfactory results for nuclear matter than the hard-core potentials now available. (auth)

42688 STUDIES OF PROTON GROUPS FROM THE REACTION $F^{19}(d,p)F^{20}$. A. Z. El-Behay, M. A. Farouk, V. J. Gontchar, V. A. Loutsik, M. H. Nassef, and I. I. Zaloubovsky (Atomic Energy Establishment, Cairo). Nucl. Phys., 56: 224-40(July 1964).

Angular distributions, excitation functions, and cross sections of most proton groups resulting from the reaction $^{19}F(d,p)^{20}F$ in the deuteron energy range 0.8 to 2.5 Mev were measured. Comparison of experimental results with the simple Butler theory is carried out. Dependence of the interaction radius R on deuteron energy and Q value is examined, reduced widths are calculated, and a detailed analysis of the results is given. (auth)

42689 SOME CONSIDERATIONS ON THE ft VALUES *OF THE FIRST-FORBIDDEN BETA TRANSITIONS.* P. Lipnik and J. W. Sunier (Laboratoire de Physique des Hautes Energies, EPF, Zurich). Nucl. Phys., 56: *241-51(July 1964).*

A survey of the ft values of the first-forbidden beta de*cay is presented. The unique transitions ($|\Delta J| = 2$) are characterized* by small fluctuations of the comparative half life, independently of the nuclear charge. The ft val*ues of the $|\Delta J| = 1$ and $\Delta J = 0$ beta transitions show large* fluctuations which are due to selection rules and/or cancellation effects affecting the nuclear matrix elements. A discussion is opened on the nature of the relation between the nuclear matrix elements and the ξ approximation behavior of the observables related to the first-forbidden beta decay. (auth)

42690 NEW DATA ON Am^{243} AND Am^{241} α-DECAYS. S. A. Baranov, V. M. Kulakov and V. M. Shatinskii (Kurchatov Atomic Energy Inst., Moscow). Nucl. Phys., 56: 252-8(July 1964).

The α decays of ^{243}Am and ^{241}Am are investigated. The α spectra of these nuclei *reveal* new fine-structure α groups, some of which belong to ^{243}Am. The proposed interpretation of new ^{239}Np and ^{237}Np levels seems to indicate new rotational *bands corresponding to the orbitals* $\frac{3}{2}^-$ [521] $\frac{5}{2}^+$ [651] and made possible the classification of some levels as collective. (auth)

42691 (α,p) AND (α,α') REACTIONS IN ARGON. N. O. Lassen and Clive Larsen (Universitet, Copenhagen). Nucl. *Phys., 56: 259-72(July 1964).*

Argon was bombarded with α particles of energy 20 Mev and less. Protons and α particles emitted in various directions in small solid angles were recorded by means of gridded ionization chamber. The upper end of the proton energy spectrum showed groups corresponding to transitions to individual low-lying levels in ^{43}K. Angular distributions for some of the groups were obtained. The main proton spectrum is an evaporation spectrum, and values for the nuclear temperature were obtained. It was found that the group of secondary emitted protons, in (α,xp) reactions, was quite small, in contrast to the case when Ca, Cu, or other targets were used, but in agreement with the expected behavior. Cross sections for $^{40}Ar(\alpha,p)^{43}K$ and $^{40}Ar(\alpha,pn)^{42}K$ were measured. Spectra of scattered α particles show strongly populated collective levels in ^{40}Ar corresponding to the known 3^- and 5^- levels in ^{40}Ca. (auth)

42692 SPECTRUM OF Lu^{172} CONVERSION ELECTRONS WITH ENERGIES HIGHER THAN 750 kev. B. S. Dželepov, A. I. Medvedev, S. A. Shestopalova, and I. F. Uchevatkin (Mendeleev All-Union Metrology Research Inst., Leningrad). Nucl. Phys., 56: 273-82(July 1964).

The ^{172}Lu conversion spectrum is measured with a β spectrometer with double-angle focusing in the energy interval from 750 to 2560 kev. The 84 conversion lines detected correspond to 45 transitions. (auth)

42693 SPECTRUM OF Lu^{169} + Lu^{170} CONVERSION ELECTRONS WITH ENERGIES HIGHER THAN 1000 Kev. B. S. Dželepov, A. I. Medvedev, S. A. Shestopalova, and I. F. Uchevatkin (Mendeleev All-Union Meteorology Research Inst., Leningrad). Nucl. Phys., 56: 283-99(July 1964).

The conversion electron spectrum of ^{169}Lu + ^{170}Lu is investigated in the energy interval of 1040 to 3250 kev using a β spectrometer with double $\pi\sqrt{2}$-angle focusing. Altogether, 174 transitions are detected; 23 transitions are ascribed to ^{169}Lu (including 13 detected for the first time) and 113 transitions are ascribed to ^{170}Lu (including 67 detected for the first time). For 38 transitions isotope identification remains an open question. (auth)

42694 π^0-MESON PRODUCTION BY PROTONS OF COMPLEX NUCLEI. A. F. Dunaitsev and Yu. D. Prokoshkin (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., 56: 300-4(July 1964).

The angular distribution of γ quanta from the decay of mesons (π^0) produced in proton-nucleus collisions was measured with a γ telescope. The values of the meson (π^0) production cross section and the energy dependence of the carbon cross section in the 175–665 Mev region were obtained. (auth)

42695 EFFECTIVE NUCLEON-NUCLEON INTERACTION IN NUCLEAR MATTER. M. Amusya (Ioffe Inst. of Physics and Tech., Leningrad). Nucl. Phys., 56: 305-21 (July 1964).

The effective interaction between particles in a homogeneous multi-fermion medium is considered. It is assumed that the potential of an interaction between free particles consists of two parts: the attraction U of radius b and repulsion V of radius a, the density p of particles in the system being such that $ap^{1/3} \ll 1$ and $bp^{1/3} \gg 1$. Collective excitations connected with the presence of repulsive as well as of attractive forces are studied. The cross sections are obtained for the absorption and inelastic scattering of particles moving in the medium due to the appearance of these collective excitaions. The results thus obtained are applied to non-homogeneous systems and in particular to heavy nuclei. It is shown that the effective nucleon-nucleon interaction on the surface of nuclei is smaller in magnitude but larger in radius than for free nucleons; also the admixture of exchange forces increases on the surface. It is shown that in inelastic scattering of nucleons of 50 to 150 Mev (in the (nn) and (pp) as well as in the (np) processes) collective oscillations with an energy of the order of 15 to 25 Mev, are excited, which are due to the presence of nucleon-nucleon exchange forces of long range. The dependence of the excitation cross section on nucleon energy is obtained. (auth)

42696 RADIATIVE PROTON CAPTURE CROSS-SECTIONS IN HEAVY NUCLEI. P. J. Daly (Oxford Univ. and Rutherford High Energy Lab., Harwell, Berks, Eng.) and P. F. D. Shaw. Nucl. Phys., 56: 322-30(July 1964).

Induced radioactivity methods were used to measure radiative capture cross sections in ^{130}Te, for protons of bombarding energy 5 to 20 Mev, ^{142}Ce (5–50 Mev) and ^{209}Bi (30–150 Mev). The results are compared with statistical theory predictions. (auth)

42697 DIRECT RADIATIVE PROTON CAPTURE REACTIONS IN CERIUM AND BISMUTH. P. J. Daly (Oxford Univ. and Rutherford High Energy Lab., Harwell, Berks, Eng.), J. R. Rook, and P. E. Hodgson. Nucl. Phys., 56: 331-6(July 1964).

The direct radiative capture cross section is evaluated using the formalism of Lane and Lynn with a diffuse optical potential and an improved method of evaluating the integrals. These refinements are found to worsen the agreement with experiment. Calculations are also made for the proton capture reactions on cerium and bismuth studied by Daly and Shaw and the theory is found able to account for the data above 20 Mev, but not at lower energies. (auth)

42698 THE 1315, 1362 AND 1363 kev RESONANCES IN THE $^{27}Al(p,\gamma)^{28}Si$ REACTION AND THE PROPERTIES OF THE 6.88 Mev DOUBLET STATE IN ^{28}Si. R. Nordhagen and A. Tveter (Universitetet, Oslo). Nucl. Phys., 56: 337-50(July 1964).

Gamma spectra, branching ratios, and γ-ray yields were measured for the resonances in the $^{27}Al(p,\gamma)^{28}Si$ reaction at 1315, 1362, and 1363 kev. Angular correlation measurements were used to find the spin of the 1315-kev resonant level and of a state at 6.88 Mev in ^{28}Si. The results are compared with the results of α-particle yield and angular distribution measurements from the same resonant level, and the spin assignments obtained from both types of measurements are in excellent agreement. Thus the 1315-kev resonant level (excitation energy 12.86 Mev) has spin and parity 4^+ and the 1363 kev resonance (excitation energy 12.90 Mev) has spin and parity 2^+. The 1362-kev resonant level (excitation energy 12.90 Mev) is tentatively assigned the spin and parity 4^+, due to the detailed similarity between the γ spectra from this level and the one at 1315 kev. One of the two states at 6.88 Mev in ^{28}Si is found to decay almost exclusively (≈90%) by transitions to the first excited state. This 6.88-Mev state has spin 4. (auth)

42699 THE HYDRODYNAMIC MODEL AND THE SHELL MODEL. A. Herzenberg and R. Phythian (Univ. of Manchester, Eng.). Nucl. Phys., 59: 529-50(Nov. 1964).

The particle-hole wave equation is discussed for collective states whose resonance energy E_x is elevated well above the order of magnitude Δ of the energy of important contributing particle-hole pairs. An expansion in powers of $(\Delta/E_x)^2$ is shown to lead to a hydrodynamic equation in lowest order. Higher order terms give a shift of the resonance energy, which may be estimated simply, and a damping of the collective state by the excitation of particle-hole pairs that happen to be in resonance with it. The analysis is confined to closed shell nuclei with a normal ground state. The treatment is applied to the giant dipole resonance, where it is also shown that if $(\Delta/E_x)^2$ is small, the calculation of the photon cross section reduces to the hydrodynamic calculation and yields the same value. (auth)

42700 A STUDY OF THE REACTIONS $U^{238}(d,p)U^{239}$ AND $U^{235}(d,p)U^{236}$. B. E. F. Macefield (Oxford Univ.) and R. Middleton. Nucl. Phys., 59: 561-72(Nov. 1964).

Spectra and angular distributions for the $^{238}U(d,p)^{239}U$ and $^{235}U(d,p)^{236}U$ reactions were obtained and compared with the predictions of the Nilsson model and DWBA calculations. Predicted and observed intensities agree within experimental uncertainties. (auth)

42701 ENERGY DEPENDENCE OF (d,p) REACTIONS ON HEAVY MASS TARGETS. B. E. F. Macefield (Oxford Univ.). Nucl. Phys., 59: 573-9(Nov. 1964).

The energy dependence of (d,p) reactions on heavy mass targets is investigated in the energy range 7–40 Mev. It is concluded that nuclear structure information is most likely to be obtained in the range 20–25 Mev. (auth)

42702 POLARIZATION OF NEUTRONS IN LOW-ENERGY ELASTIC SCATTERING FROM SPHERICAL NUCLEI. M. Z. Rahman Khan (Muslim Univ., Aligarh, India). Nucl. Phys., 59: 580-2(Nov. 1964).

Optical model calculations of the polarizations of 0.38 and 0.98-Mev neutrons due to elastic scattering are reported. Experimental elastic scattering cross sections are used directly in computing the polarization. The calculations account for the data qualitatively and give a spin-orbit strength consistent with the requirements of the shell model. The calculated polarization strongly depends on the strength of the imaginary part of the optical potential but has little dependence on the imaginary part of the spin-orbit potential. Thus quantitatively good fits to the polarization data would be possible when details of the radial distribution of the imaginary part of the optical potential at low energies are accurately obtained. (auth)

42703 TOTAL NEUTRON CROSS SECTIONS OF C, Ca AND Fe BETWEEN 8 AND 14 Mev. F. Manero, B. H. Armitage, J. M. Freeman, and J. H. Montague (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 59: 583-93(Nov. 1964).

Total neutron cross sections for carbon were measured between neutron energies of 7.0 and 14.3 Mev and for calcium and iron between 8.3 and 14.3 Mev. The measurements have an accuracy of ±2% or better; they were taken at intervals of approximately 0.1 Mev in neutron energy with neutron energy spreads of less than ±0.05 Mev. The carbon cross section shows a number of broad resonances, confirming the results of others. The calcium and iron cross sections are essentially featureless. (auth)

42704 ANGULAR CORRELATIONS IN THE REACTION $C^{12}(p,p'\gamma)C^{12*}$ AT 40 Mev. H. S. Adams and Norton M. Hintz (Univ. of Minnesota, Minneapolis). Nucl. Phys., 59: 601-14(Nov. 1964).

The inelastic proton-gamma angular correlation was studied for the reaction $^{12}C(p,p'\gamma)^{12*}C$ (4.43 Mev) at E_p = 39.3 Mev. Data were taken in the scattering plane and for the azimuthal correlation. The general features of the data are well described by the DWBA analysis of Levinson and Banerjee. The results are sensitive to the coupling scheme assumed for the ^{12}C wave functions. Reliable conclusions cannot be given at this time, however, since the Levinson and Banerjee DWBA calculation neglected the spin dependence of the two-body interaction. (auth)

42705 MATRIX ELEMENTS FOR POLARIZED FERMION SCATTERING. Micha Hofri and Asher Peres (Israel Inst. of Tech., Haifa). Nucl. Phys., 59: 618-24 (Nov. 1964).

Explicit formulas are given for matrix elements of the type $\nu(p)\gamma^{\alpha}\gamma^{\beta} \ldots \gamma^{\delta}\nu(q)$, where $\nu(p)$ and $\nu(q)$ are normalized Dirac eigenspinors, the spins of which are defined by the projections of the Foldy-Wouthuysen mean spin operator on arbitrary axes. (auth)

42706 EXCITED STATES IN ^{29}P BY THE REACTION $^{32}S(p,\alpha)^{29}P$. Hiroyasu Ejiri, Yozo Nogami, Yutaka Nakajima, Kinuko Horie, Kiichi Etoh, and Akira Sugawa (Tokyo Univ.). Nucl. Phys., 59: 625-32(Nov. 1964).

The reaction $^{32}S(p,\alpha)^{29}P$ was investigated by use of 14.5-Mev protons. Alpha particles were analyzed with a broad range magnetic spectrograph and were detected with nuclear plates. Seven alpha groups from the reaction $^{32}S(p,\alpha)^{29}P$ were found. These alphas to the ground state and the excited states in ^{29}P at 1385 ± 20, 1959 ± 20, 2410 ± 20, 3108 ± 20, 3446 ± 20, and 4076 ± 20 kev. A Q value of this reaction was measured as Q = 4171 ± 20 kev. The angular distribution for each alpha group was measured and analyzed in terms of direct reaction theory. A brief discussion is presented on the properties of the excited states in ^{29}P and the (p,α) reaction. (auth)

42707 PHOTOPRODUCTION OF PIONS FROM H_3 AND He_3. G. Ramachandran and K. Ananthanaryanan (MATSCIENCE, Madras, India). Nucl. Phys., 59: 633-40(Nov. 1964).

Photoproduction of mesons (π) from the three-nucleon targets ^3H and ^3He is studied using the impulse approximation. The sensitivity of the cross sections to changes in the nucleon magnetic moments is also examined. (auth)

42708 STRONG ABSORPTION MODEL ANALYSIS OF 15 Mev DEUTERON ELASTIC SCATTERING. W. E. Frahn (Univ. of Cape Town) and L. P. C. Jansen. Nucl. Phys., 59: 641-50(Nov. 1964).

The angular distributions of 15-Mev deuterons elastically scattered by 23 target nuclei ranging from aluminum to lead are analyzed by means of the strong absorption model. Generally consistent values of the three model parameters r_0 (radius), d (diffuseness) and $\mu/4\Delta$ (real phase shift) are obtained. The systematic behavior of the data is similar to that observed for other strongly absorbed composite projectiles such as ^3He, alpha particles, and heavy ions. The presence of all typical features arising from interference between diffraction-scattered and Coulomb-scattered waves indicates that the elastic deuteron interaction is confined to the nuclear surface. Characteristic anomalies and deviations from the overall diffraction pattern for certain groups of target nuclei probably reflect nuclear structure effects. (auth)

42709 DIFFRACTION MODEL FOR SINGLE-NUCLEON TRANSFER REACTIONS BETWEEN COMPLEX NUCLEI. W. E. Frahn and R. H. Venter (Univ. of Stellenbosch, Cape Province, South Africa). Nucl. Phys., 59: 651-9(Nov. 1964).

Single-nucleon transfer reactions between complex nuclei are treated as quasi-elastic processes in the framework of the strong-absorption model for nuclear scattering. Rather general assumptions about the form of the scattering function in l-space lead to simple expressions for the angular distribution of the outgoing particles. Analyses of typical sets of single-neutron transfer data yield fairly consistent values of the three parameters of the model, which can be interpreted semiclassically in terms of the radius and width of the reaction zone and the strength of the transfer interaction. While decreasing Coulomb interference the transfer angular distribution changes into an oscillatory stripping pattern. Characteristic diffraction effects in these reactions are pointed out, and some general wave-mechanical features or surface reactions are discussed. (auth)

42710 NUMERICAL CALCULATIONS OF MULTIPLE COULOMB EXCITATION PROBABILITIES FOR ODD-MASS NUCLEI. E. M. Bernstein (Univ. of Texas, Austin). Nucl. Phys., 59: 670-2(Nov. 1964).

Alder and Winther's theoretical predictions of excitation probabilities for multiple E2 Coulomb excitation of rotational states in odd-mass nuclei were evaluated on a high speed computer. For ground state spin ½, it is shown that the excitation probabilities are related in a very simple manner to the excitation probabilities for even nuclei. (auth)

42711 A SEARCH FOR TWO-QUANTUM DECAY BY DOUBLE INTERNAL CONVERSION IN THE DECAY OF In^{114m}. P. Kleinheinz, L. Samuelsson, R. Vukanović, and K. Siegbahn (Uppsala Univ.). Nucl. Phys., 59: 673-87 (Nov. 1964).

The reported two-quantum decay of the 192-kev isomeric state in ^{114}In by double internal conversion was reinvestigated applying electron-electron coincidence techniques with magnetic energy selection. Results show that coincident electrons of appropriate energy are emitted by Møller scattering from thin sources. Upper intensity limits were determined for the different modes of two-quantum de-excitation involving conversion electrons, showing considerably smaller probabilities for these processes than suggested by present theory. Conversion ratios of the 192-kev E4 transition in ^{114}In and of the 173-kev M1 + E2 and 247-kev E2 transitions in ^{111}Cd were determined. (auth)

42712 HIGH-ENERGY NUCLEAR INTERACTIONS FROM THE INTERNATIONAL CO-OPERATIVE EMULSION FLIGHT. I.C.E.F. COLLABORATION. F. Brisbout (Univ. of Sydney), C. Gauld, T. Gray, et al. Nuovo Cimento (1), 1: Suppl. No. 4, 1039-90(1963).

The experimental procedures used and the basic data obtained in the international cooperative emulsion flight are presented. (C.E.S.)

42713 ANALYSIS OF HIGH-ENERGY NUCLEAR INTERACTIONS FROM THE INTERNATIONAL CO-OPERATIVE EMULSION FLIGHT. M. Koshiba (Univ. of Chicago), C. H. Tsao, C. L. Deney, R. Fricken, R. W. Huggett, B. Hildebrand, R. Silberberg, and J. J. Lord. Nuovo Cimento (1), 1: Suppl. No. 4, 1091-1117(1963).

An analysis of cosmic ray ultra-high-energy nuclear reaction data from the international cooperative emulsion flight is presented. (C.E.S.)

42714 DOUBLE MAXIMUM ANGULAR DISTRIBUTIONS AND ASYMMETRY IN HIGH-ENERGY NUCLEAR JETS. T. Coghen (Inst. of Nuclear Research, Krakow), Z. Czachowska, J. Gierula, et al. Nuovo Cimento (1), 1: Suppl. No. 4, 1157-62(1963).

Angular distribution of jets produced by singly charged or neutral primaries with $\gamma_c > 23$ were analyzed. The aim of this analysis was to check the deviation of the angular distribution from the normal shape towards the shape expected by the two-center model and to investigate the asymmetry of the emission of secondary particles. (C.E.S.)

42715 EXPERIMENTAL DETERMINATION OF THE TOTAL CAPTURE RATE OF NEGATIVE MUONS IN ^4He. R. Bizzarri, E. Di Capua, U. Dore, G. Gialanella, P. Guidoni, and I. Laakso (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (10), 33: 1497-1508(Sept. 16, 1964).

The total rate for nuclear capture of negative muons in ^4He was measured in the liquid-helium bubble chamber. A rate of $(336 \pm 75)\ s^{-1}$ is obtained in agreement with the theoretical predictions. The nuclear recoil spectrum from 930 captures of negative pions is also given. (auth)

42716 NEW LOGARITHMIC RADIATIVE CORRECTIONS TO THE HYPERFINE SPLITTING IN HYDROGENIC ATOMS. A. Layzer (Stevens Inst. of Tech., Hoboken, N. J.). Nuovo Cimento (10), 33: 1538-43(Sept. 16, 1964).

The calculation of new radiative corrections to the hyperfine splitting in hydrogenic atoms is reported. The result for the correction ΔE to the 1S state is $\Delta E/E_F = (\alpha w/\pi)(-{}^2\!/_3 \ln^2 w + \ln w \cdot [{}^8\!/_3 \ln 2 - 37/72 - 4/15])$, where $w \equiv (\alpha Z)^2$ and E_F is the lowest-order splitting. The last term is due to vacuum polarization. A brief description is given of the method of calculation, which employs the free-propagator expansion of the bound-electron Green's function. In the important case of hydrogen, the new corrections tend to slightly worsen the already unsatisfactory agreement of theory with experiment. The relevance of this result to the proton structure problem is briefly discussed. Integral expressions are given for the mean electromagnetic radius of the proton in terms of the proton charge and magnetic moment form factors in momentum space. (auth)

42717 ENERGY ESTIMATION FOR HIGH-ENERGY NUCLEAR INTERACTIONS. L. S. Peak and R. L. S. Woolcott (Univ. of Sydney). Nuovo Cimento (10), 34: 1-10 (Oct. 1, 1964).

The inaccuracies of the various energy estimators for high-energy nuclear collisions are discussed. A new method of estimation based on a two-center model is proposed, involving measurement of the quartile angle, δ, and accounting for multiple collisions. With this model $T\delta$ (where T is the energy of the created particles) is shown to be dependent upon the fireball multiplicity, and values of $T\delta$ are shown to be consistent with the model and a nucleon-nucleon charge multiplicity of ≈ 10. The method is shown to estimate primary energies more in accordance with the cosmic-ray energy spectrum than the Castagnoli method, and is further verified by comparison with machine energies. (auth)

42718 A DETECTOR FOR THE INDUCED PSEUDOSCALAR COUPLING CONSTANT. T. Ericson (CERN, Geneva), J. C. Sens, and H. P. C. Rood. Nuovo Cimento (10), 34: 51-66(Oct. 1, 1964).

The detection of partial muon capture rates in ^{16}O forms a sensitive detector for the induced pseudoscalar coupling constant. The effects of nucleon velocity terms in the weak Hamiltonian and of realistic nuclear wave-functions are investigated. Their inclusion is essential for a correct treatment of the problem. In addition to the previously suggested detector level, it is found that capture into the ground state of ^{16}N permits an almost complete elimination of nuclear physics by comparison to the β-decay rate. (auth)

42719 ACOUSTIC SATURATION OF NUCLEAR MAGNETIC RESONANCE LINES. D. P. Tewari and G. S. Verma (Univ. of Allahabad, India). Phys. Letters, 12: 97-8(Sept. 15, 1964).

The relative acoustic saturation behavior of different NMR lines, both in pure magnetic and quadripolar cases, is studied for nuclei of different spins, under the combined influence of r-f and ultrasonic fields, for a nuclear spin system for which all the lines are resolved. (T.F.H.)

42720 STATISTICAL PROPERTIES OF U^{236} SCISSION. E. Erba, U. Facchini, E. Saetta-Menichella, and F. Tonolini (Laboratori CISE, Milan and Università, Milan). Phys. Letters, 12: 109-11(Sept. 15, 1964).

The properties of the final channels, such as energy spectra, mass distributions, and neutron emission, are studied in the thermal and 14-Mev neutron-induced fission of ^{235}U. Particular attention is devoted to symmetrical fission. The validity of the model used requires that the stage preceding scission has a sufficiently long life to allow statistical decay. (T.F.H.)

42721 BETA DECAY OF Li^9. R. A. Eramjian (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 12: 112-13(Sept. 15, 1964).

Decay modes of ^{9}Li to ^{9}Be and ^{8}Be are investigated, using the intermediate-coupling shell model. The theoretical and experimental spectra, level schemes, log ft values, and other parameters are compared. (T.F.H.)

42722 REMARK ON THE NOTE "DECAY (α-Be^8) OF 16.11 Mev (2^+) LEVELS OF C^{12}." D. Dehnhard, D. Kamke, and P. Kramer (Universität, Marburg, Ger.). Phys. Letters, 12: 113-14(Sept. 15, 1964). (In German)

A coincidence experiment was previously carried out on the reaction ^{11}B(p,α)2α in order to determine the frequency of the decay ^{12}C(16.11 Mev) → 3α in comparison with the decay ^{12}C(16.11 Mev) → α + ^{8}Be → 3α. It was concluded from that experiment that at 163 kev the upper limits for participation of the decay ^{12}C(16.11 Mev) → 3α amounted to 40%. This was contrary to results that indicated that the decay of ^{12}C(16.11 Mev) was preponderantly to 3α. A Dalitz diagram was prepared for the ^{11}B(p,α)2α reaction at 163 kev. It is shown that the distinction of 3-particle decay from cascade decay is possible only if proof of the whole Dalitz diagram is dispensed with. (M.C.G.)

42723 THE REACTIONS Si^{28}(γ,p)Al^{27} AND Si^{28}(γ,α)Mg^{24}. H. Ullrich (Technische Hochschule, Karlsruhe, Ger. and Kernforschungszentrums, Karlsruhe, Ger.). Phys. Letters, 12: 114-16(Sept. 15, 1964).

The excitation functions for ^{28}Si(γ,p) and ^{28}Si(γ,α) are measured at gamma energies of 13 to 20 Mev. The outgoing-particle spectra are also measured at fixed gamma energies. Branching ratios to various energy levels of the residual nuclei are determined. The measurements are made by using as targets the ^{28}Si nuclei in Si junction detectors. (T.F.H.)

42724 PARTIALLY CONSERVED AXIAL VECTOR CURRENT AND NUCLEAR β DECAY MATRIX ELEMENTS. D. Tadić (Univ. of Zagreb). Phys. Letters, 12: 116-18 (Sept. 15, 1964).

Some of the possible consequences of partial conservation of axial vector current in nuclear beta decay are investigated. Relations between nuclear matrix elements are found and applied to $0^- \rightarrow 0^+$ and allowed transitions. Results are shown for ^{144}Pr, ^{12}N, ^{12}B, ^{22}Na, and ^{114}In. (T.F.H.)

42725 DEFORMATION AND THE ADEQUACY OF THE HARMONIC OSCILLATOR SHELL-MODEL IN 1p SHELL NUCLEI. A. B. Volkov (Universitet, Copenhagen). Phys. Letters, 12: 118-20(Sept. 15, 1964).

An attempt is made to determine the cause and influence of deformation in the light 1p shell nuclei, by calculations involving "realistic" forces. Parameters are calculated for ^{8}Be, ^{10}Be, ^{10}C, and ^{12}C, using phenomenological two-body forces that fulfill the following restrictions: they have a soft repulsive core; they give approximately the correct binding and size for ^{16}O; and they give approximately a correct average value for the effective range and scattering length. (T.F.H.)

42726 ADIABATIC AND NON-ADIABATIC COUPLED CHANNEL CALCULATIONS OF THE SCATTERING OF PROTONS BY DEFORMED NUCLEI. T. Tamura (Oak Ridge National Lab., Tenn.). Phys. Letters, 12: 121-3 (Sept. 15, 1964). (ORNL-P-194)

An adiabatic coupled-channel calculation of the cross sections for 17.5-Mev proton scattering by ^{56}Gd and ^{165}Ho is carried out, using the optical model with complex form factors. Theoretical and experimental results are compared. (T.F.H.)

42727 EXPERIMENTAL EVIDENCE FOR THE EXTINCTION OF (p,γ) YIELDS IN SINGLE CRYSTALS. E. Boegh, J. A. Davies, and K. O. Nielsen (Universitet, Aarhus, Denmark). Phys. Letters, 12: 129-30(Sept. 15, 1964).

The yields of the (p,γ) reactions in Al and Si single crystals at 410 to 465 kev are found to depend on the crystal orientation with respect to the incident proton beam. As the angle between the proton beam and the $\langle 110 \rangle$ axis in these crystals is varied from 2 to 0°, the relative gamma yield is found to fall from 100% to about 20%. (T.F.H.)

42728 ASYMPTOTIC DENSITIES IN STATISTICAL ENSEMBLES. Harvey S. Leff (Case Inst. of Tech., Cleveland). Phys. Rev., 136: A355-61(Oct. 19, 1964).

An expression for the single-eigenvalue (level) density is obtained for a class of ensembles previously considered. The method involves a continuum approximation of a discrete spectrum, and leads to the asymptotic level density as the formal solution of an integral equation. Specific results are calculated for the Jacobi, Hermite, and Laguerre ensembles. These agree with prior calculations for $\beta = 1$ and $\beta = 2$, but have the feature of containing β as an arbitrary continuously variable parameter. An analogy with a one-dimensional Coulomb gas is used to interpret results and to initiate a search for ensembles with physically realistic densities. A class of ensembles is found which has asymptotic densities whose first and second derivatives are non-negative. (auth)

42729 LIFETIME OF THE FIRST EXCITED ^{1}P$_1$ STATE OF Mg AND Ba; HFS OF Ba^{137}. Allen Lurio (Columbia Univ., New York). Phys. Rev., 136: A376-9(Oct. 19, 1964).

The lifetime of the first excited ^{1}P$_1$ state of Mg and Ba was obtained from the measured width of the zero-field level-crossing signal in the scattering of resonance radiation from an atomic beam of these elements. The results are τ(Mg) = $(1.99 \pm 0.08) \times 10^{-9}$ sec and τ(Ba) = $(8.2 \pm 0.2) \times 10^{-9}$ sec. These results are compared with previous measurements and in conjunction with other experimental results are used to obtain the intermediate coupling coefficients for the mixing of the ^{1}P$_1$ and ^{3}P$_1$ states. From a measurement of the one observable high-field level crossing in ^{137}Ba, the dipole coupling constant for the 6s6p ^{1}P$_1$ state is found to be -113.2 ± 1.0 Mc in good agreement with the results of Jackson and Tuan. The quadrupole moment of the ^{137}Ba is calculated to be 0.20×10^{-24} cm^2 from the data of Jackson and Tuan. (auth)

42730 LOW-LYING STATES OF F^{19}. R. M. Dreizler (Australian National Univ., Canberra). Phys. Rev., 136: B321-9(Oct. 26, 1964).

The core-particle coupling model employed previously for the interpretation of the low-lying positive-parity states of ^{21}Ne is applied to ^{19}F. The lowest positive-parity states of ^{19}F are investigated in terms of the coupling of a 2s-1d hole to the ^{20}Ne core. Satisfactory agreement with experimental results is obtained for parameters which compare well with the parameters used in ^{21}Ne. The negative-parity states of ^{19}F require the coupling of both a 2s-1d and a 1p hole. The large number of parameters in this model does not allow any definite conclusions for this case, though the preliminary results yield a reasonable interpretation of the E1 and E3 transition data. (auth)

42731 NUCLEAR ENERGY LEVELS OF Gd^{156} AS POPULATED BY β EMISSION FROM Eu^{156}. N. F. Peek, J. A. Jungerman, and C. G. Patten (Univ. of California, Davis). Phys. Rev., 136: B330-40(Oct. 26, 1964).

Energy levels of ^{156}Gd populated by the beta decay of ^{156}Eu were studied. Energies of 36 transitions were determined absolutely using the Davis solenoidal spectrometer. Twenty-nine transitions were integrated into a decay scheme. In several cases external-conversion technique was used to assign multipolarities. Level energies (in kev), spins, and parities determined are: 88.95, 2+; 288.14, 4+; 1153.9, 2+; 1168.0, 0, 1, 2+; 1242.2, 1−; 1319.3, 2−; 1366.1, 1−; 1965.5, 1, 2+; 2026.2, 1, 2+; 2180.5, 1+; 2186.3, 1+; 2202.5, 0, 1, 2+, and 2203.2. (auth)

42732 ISOTOPIC EFFECTS IN THE X-RAY SPECTRUM OF MUONIC ATOMS OF Ca^{40} AND Ca^{44}. J. A. Bjorkland (Argonne National Lab., Ill.), S. Raboy, C. C. Trail, R. D. Ehrlich, and R. J. Powers. Phys. Rev., 136: B341-6(Oct. 26, 1964).

The 2p → 1s transitions in muonic atoms of ^{44}Ca and ^{40}Ca were compared by use of a NaI(Tl) scintillation spectrometer with an anticoincidence annulus of NaI(Tl). It was found that the energy of the 2p → 1s transition in ^{40}Ca is 0.9 ± 0.3 kev greater than that in ^{44}Ca. (auth)

42733 ANGULAR CORRELATION MEASUREMENTS IN THE DECAY OF Cd^{115m}. V. R. Pandharipande, R. P. Sharma, and Girish Chandra (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., 136: B346-50(Oct. 26, 1964).

Levels in ^{115}In at 650, 930, 1125, 1285, 1420, and 1540 kev are populated in the decay of ^{115m}Cd (43 days). The experimentally determined coefficients of the gamma-gamma angular correlation function for the cascades 485–930 and 160–1125 kev are $A_2 = -0.023 \pm 0.005$, $A_4 = 0.013 \pm 0.012$; $A_2 = -0.107 \pm 0.011$, $A_4 = 0.021 \pm 0.017$, respectively. The coefficient of the $\beta-\gamma$ directional correlation function between the unique first forbidden beta transition and the following 930-kev gamma ray is found as $A_2 = 0.0088 \pm 0.0076$. Spin assignments for the excited states in ^{115}In, which are consistent with the experimental results, are $\frac{7}{2}$ (930 kev), $\frac{11}{2}$ (1125 kev), $\frac{9}{2}$ (1280 kev), and $\frac{9}{2}$ (1420 kev). The quadrupole-dipole mixing was determined for the cascading gamma rays. From delayed-coincidence measurements, the half-lives of 930- and 1420-kev levels were found to be shorter than 3×10^{-10} and 1.1×10^{-9} sec, respectively. (auth)

42734 ENERGY LEVELS OF Dy^{165}. R. K. Sheline (Florida State Univ.), W. N. Shelton, H. T. Motz, and R. E. Carter. Phys. Rev., 136: B351-65(Oct. 26, 1964). (LADC-6466)

Eighty levels which were observed in ^{165}Dy utilizing the reaction ^{164}Dy(d,p)^{165}Dy with 12-Mev deuterons are reported. The ground-state Q for the reaction was determined as 3488 ± 5 kev. Thermal neutron capture gamma rays from a sample of natural dysprosium were measured over the energy range of 900 to 6000 kev. The neutron binding energy of ^{165}Dy is determined to be 5715 ± 4 kev. These complimentary methods are a considerable aid in analysis, because the observed intensities permit spin assignments for these levels populated by the strong high-energy capture gamma rays and several of the (d,p)-populated levels. The analysis suggests the following spectroscopic interpretation (band head energies, kev, in parentheses; Nilsson asymptotic quantum numbers in brackets): (ground state), $\frac{7}{2}+[633]$ with superimposed rotational to $\frac{13}{2}+$; (108.16), $\frac{1}{2}-[521]$ rotational band to $\frac{11}{2}-$; (184), $\frac{5}{2}-[512]$ rotational band to $\frac{11}{2}-$; (~535), $\frac{5}{2}-[523]$ rotational band to $\frac{9}{2}-$; (539), $\frac{3}{2}+\gamma$ band built on $\frac{7}{2}+[633]$ with rotational members to $\frac{9}{2}+$; (574), $\frac{3}{2}-\gamma$ band on $\frac{1}{2}-[521]$ with rotational members to $\frac{7}{2}-$; and (606), $\frac{3}{2}-[521]$? rotational band to $\frac{5}{2}-$. The gamma vibrational bands are the first postulated on odd-neutron intrinsic Nilsson orbitals. An analysis is made of the K-2 gamma bands of odd-A nuclei. Their energy systematics is found to mirror closely that of the gamma bands of neighboring even-even nuclei. (auth)

42735 STUDY OF THE 7.285-Mev LEVEL IN LEAD-208 USING A ROTOR TECHNIQUE. B. Arad, G. Ben-David, and Y. Schlesinger (Israel Atomic Energy Commission, Yavne). Phys. Rev., 136: B370-73(Oct. 26, 1964). (IA-931)

The 7.285-Mev level in ^{208}Pb, excited by thermal neutron capture gamma rays from iron, was studied using a rotating target to vary the energy of the gamma rays seen by the target. Energy shifts of −1.07, −1.75, +1.65, and +2.57 ev were achieved, and the observed changes in scattered intensity are consistent with the resonant ^{208}Pb level lying 6.5 ± 1 ev below the iron capture gamma-ray line. (auth)

42736 PROPERTIES OF THE 4.431-Mev EXCITED STATE OF Na^{23}. F. R. Metzger (Franklin Inst., Swarthmore, Penna.). Phys. Rev., 136: B374-9(Oct. 26, 1964).

Using the Doppler-broadened 4.43-Mev gamma line from the reaction ^{15}N(p,α)^{12*}C as the exciting radiation, resonance fluorescence from the 4.431-Mev level in ^{23}Na was observed. The 4.431-Mev ground-state transition, accounting for (95 ± 3)% of the de-excitations, exhibits an isotropic angular distribution. This fact and the absence of branching to the 0.44-Mev $\frac{5}{2}+$ level make $\frac{1}{2}$ the most probable spin assignment. With this spin value, a self-absorption study leads to a partial width $\Gamma_0 = (2.14 \pm 0.10)$ ev for the ground-state transition. When this width is combined with the observed branching, a total width $\Gamma = (2.25 \pm 0.20)$ ev is obtained for the 4.431-Mev level in ^{23}Na, which is found to populate also the 2.39-Mev excited state in (5 ± 3)% of its decays. A comparison of scattering and self-absorption data for different values of the ratio of natural width to Doppler width confirms the spin assignment of $\frac{1}{2}$ to the 4.431-Mev level, which might be the first member of the K = $\frac{1}{2}-$ band based on the Nilsson orbit 14. For a value $\eta = +4$ of the deformation parameter, the E1 transition probability calculated with Nilsson wave functions agrees with the experimental value. (auth)

42737 TIME-DEPENDENT HARTREE-FOCK THEORY APPLIED TO Ne^{20} AND Mg^{24}. W. H. Bassichis (Weizmann Inst. of Science, Rehovoth, Israel), C. A. Levinson, and I. Kelson. Phys. Rev., 136: B380-4(Oct. 26, 1964).

The time-dependent Hartree-Fock method is applied to the even-even nuclei ^{20}Ne and ^{24}Mg. The starting point of the calculation is a static Hartree-Fock solution, with the assumptions that in both the ground and the excited state, the deformed nuclei are axially symmetric, that the self-consistent wave functions have the usual shell-model radial dependence, and that the two-body interaction is the Rosenfeld mixture proposed by Elliott and Flowers. Application of the method yields intrinsic excited states corresponding to the rotational bands of the nuclei being considered. The calculated differences in energy between the lowest lying members of these bands agree quite well with experiment. The spurious solutions or states, corresponding to the invariance of the system under rotation about the axis of symmetry, occur with zero excitation energy, as predicted, when correlation effects in the ground state are included. The effect of these correlations on the energy spectra for the nonspurious solutions is shown to be negligible. (auth)

42738 APPLICATION OF TIME-DEPENDENT HARTREE-FOCK THEORY TO Ne^{20}: ODD-PARITY BANDS. W. H. Bassichis (Weizmann Inst. of Science, Rehovoth, Israel) and I. Kelson. Phys. Rev., 136: B385-7(Oct. 26, 1964).

The constraint that the ^{16}C core be inert with respect to particle-hole excitations in ^{20}Ne, imposed in a recent calculation is relaxed. In this time-dependent Hartree-Fock treatment of ^{20}Ne, excitations are considered in which a particle from the energetically highest level in the core is promoted to a level in the s-d shell. The wave function describing the core particle is assumed to be given by the shell model. The single-particle wave functions and energy spectra ascribed to the outer four particles are those obtained by a static Hartree-Fock calculation done previously. Such excitations give rise to excited intrinsic states of odd parity, the lowest lying of which correspond to the observed odd-parity rotational bands. The agreement between the observed and calculated band positions gives credence to the assumption, proposed in the earlier calculation, that the ^{16}O core is nearly spherical in ^{20}Ne despite the deformation of the orbitals of the outer particles. (auth)

42739 THERMAL NEUTRON CAPTURE BY DEUTERIUM AND STRUCTURE OF THE THREE-BODY WAVE FUNCTION. T. K. Radha and N. T. Meister (Stanford Univ., Calif.). Phys. Rev., 136: B388-95(Oct. 26, 1964).

The study of three-nucleon wave functions has recently drawn considerable attention owing to experiments on elastic scattering of high-energy electrons from ^3H and ^3He. An attempt is made to obtain independent information on these wave functions using the available experimental data on slow-neutron capture by deuterium. This reaction goes mainly through magnetic dipole radiation from both exchange and spin magnetic-moment interaction. Three types of three-body wave functions, Gaussian, Irving, and Irving-Gunn, are considered. An upper limit on the probability of the S′ state of mixed symmetry ($^2S_{1/2}$ state with $T = 1/2$) is deduced from the experimental capture rate. (auth)

42740 EFFECT OF VELOCITY-DEPENDENT FORCES ON THE INTEGRATED CROSS SECTION OF PHOTONUCLEAR REACTIONS. L. Dohnert and O. Rojo (Universidad Central de Venezuela, Caracas). Phys. Rev., 136: B396-8 (Oct. 26, 1964).

The effect of correlations between nucleons is discussed for the integrated cross section of photonuclear reactions, considering only the central force. The two-body potential used is well-behaved and velocity-dependent. The calculations performed by first-order perturbation theory give an increase of about 14% for the integrated cross section above the value found by neglecting correlations. (auth)

42741 ISOTOPIC-SPIN SELECTION-RULE VIOLATION IN THE $Ne^{20}(d,\alpha)F^{18}$ REACTION. G. M. Matous and C. P. Browne (Univ. of Notre Dame, Ind.). Phys. Rev., 136: B399-404(Oct. 26, 1964).

A large isotopic-spin violation was observed in the $^{20}Ne(d,\alpha)^{18}F$ reaction. The yield to the second T = 1 level (3.063 Mev) in ^{18}F was measured and compared with the yield to an adjacent (3.133 Mev) T = 0 level. The ratio of the yields to these two levels, averaged over angles from 50 to 140°, for an input energy of 4.00 Mev, was found to be 0.40. A value of approximately 1 was found for this ratio using the $^{16}O(^3He,p)^{18}F$ reaction. The isotopic-spin selection-rule breakdown is attributed to Coulomb mixing of states in the compound nucleus ^{22}Na and in the residual nucleus ^{18}F. Angular distributions of 11 proton groups from the $^{16}C(^3He,p)^{18}F$ reaction and of seven alpha groups from the $^{20}Ne(d,\alpha)^{18}F$ reaction are presented. (auth)

42742 DEPENDENCE OF THE ANGULAR DISTRIBUTION OF THE (d,p) REACTION ON THE TOTAL ANGULAR-MOMENTUM TRANSFER. L. L. Lee, Jr., and J. P. Schiffer (Argonne National Lab., Ill.). Phys. Rev., 136: B405-9(Oct. 26, 1964).

Experimental evidence is presented that the angular distribution of the (d,p) reaction depends not only on the orbital angular momentum l but also on the total angular-momentum transfer $J = l \pm 1/2$. For l = 1, marked differences appear between $J = 1/2$ and $3/2$ at angles greater than 90° in medium-weight nuclei. Lesser differences also appear for l = 2 and l = 3 transitions at back angles. A marked dependence on J is also observed for l = 2 transitions at forward angles. The experimental evidence for such effects is presented. (auth)

42743 $O^{16}(\gamma,n)O^{15}$ REACTION NEAR 17.6 Mev. Walter Del Bianco, W. E. Stephens, and J. Wiza (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 136: B418-19(Oct. 26, 1964).

The photonuclear activation cross section of ^{16}O near 17.6 Mev was investigated using monochromatic gamma rays from the $^7Li(p,\gamma)$ reaction. The proton energy was set for the 441-kev resonance and the gamma-ray energy angular dependence was used to determine the relative (γ,n) cross section at the energies 17.571, 17.618, and 17.666 Mev. The absolute cross section was determined at 17.618-Mev photon energy to be 0.55 ± 0.08 mb. (auth)

42744 DETERMINATION OF THE TOTAL ANGULAR MOMENTUM OF RESIDUAL NUCLEAR STATES FROM DEUTERON STRIPPING ANGULAR DISTRIBUTIONS. K. R. Greider (Yale Univ., New Haven). Phys. Rev., 136: B420-5(Oct. 26, 1964). (NYO-1807-5)

A model based on diffraction techniques yields general formulas for large-angle differential cross sections in deuteron stripping (and other rearrangement) reactions in which the entrance- and exit-channel particles are strongly absorbed. It is found that for a spin-zero target, the character of the large-angle distributions depends critically on the angular-momentum transfer L (or parity of the residual state) in an unusual way. For L even, cross sections exhibit oscillations that have twice the period of the usual forward-angle stripping oscillations, while for L odd, there is almost no oscillatory structure. Furthermore, the even-L oscillations for L = 4n are out of phase with those for L = 4n + 2, n = 0, 1, • • •. A unique determination of the total spin $J = L \pm 1/2$ of the residual nuclear state in deuteron stripping is possible when entrance- and exit-channel spin-orbit scattering, proportional to $\sigma \cdot l$, is introduced into the diffraction model. The spin-orbit amplitude is characterized by distributions of opposite parity from the spin-independent amplitude. For the case of L odd, the spin-independent amplitude is a relatively smooth function of angle, characteristic of odd-parity distributions, while the spin-dependent amplitude exhibits the even-parity (L ± 1) large-angle diffraction oscillations. The analysis for L = 1 shows that the $J = L + 1/2 = 3/2$ state is characterized by an L = 0 angular distribution for the spin-dependent amplitude, while the $J = 1/2$ state shows oscillations typical of L = 2. Consequently, a unique phase rule is obtained for identification of the total spin J of the residual state since the large-angle oscillations for $J = 3/2$ are out of phase with those for $J = 1/2$. A comparison of the predictions of the model with recent experiments is also presented. (auth)

42745 INTERACTION OF HIGH-ENERGY PROTONS AND HELIUM IONS WITH NIOBIUM. Ralph G. Korteling and Earl K. Hyde (Univ. of California, Berkeley). Phys. Rev., 136: B425-37(Oct. 26, 1964).

Production cross sections were measured radiochemically for isotopes of niobium, zirconium, copper, nickel, and sodium produced in niobium targets bombarded with 240, 320, 500, and 720-Mev protons and with 320, 500, 720, and 880-Mev helium ions. For the proton bombardments these cross sections were also calculated by the Monte Carlo method with an electronic computer by use of the conventional two-step model of high-energy reactions. Interpolated results of a previous calculation by Metropolis and co-workers were used to simulate the effect of the initial high-energy cascade. These results were used in turn as input data for an evaporation calculation. A comparison of the theoretical yields of final products with the observed yields indicates that the theory accounts fairly well for low-deposition-energy products (niobium and zirconium isotopes), and quite well for high-deposition-energy products (copper and nickel isotopes). The theory fails completely to account for the yields of sodium isotopes, whose production must be ascribed to fragmentation, as noted previously by others. No Monte Carlo calculations were made for helium-ion-induced reactions. However, a comparison of yields of products of helium-ion- and proton-induced reactions shows a remarkable similarity at all energies and for all products. The main difference is a greater yield by a factor of two in the case of helium-ion bombardments. The implications of this for the mechanism of fragmentation are discussed. During the course of this work a 15-min positron emitter was discovered and identified as ^{88}Nb.

42746 INELASTIC DEUTERON SCATTERING AND (d,p) REACTIONS FROM ISOTOPES OF Ti. I. Ti^{50}(d,p)Ti^{50}. P. D. Barnes (Yale Univ., New Haven), C. K. Bockelman, Ole Hansen, and A. Sperduto. Phys. Rev., 136: B438-46 (Oct. 26, 1964). (MIT-2098-49)

The reaction ^{50}Ti(d,p)^{51}Ti was investigated at 6-Mev bombarding energy. The proton spectra were recorded simultaneously at 24 scattering angles with an energy resolution of 15 kev in the multigap heavy-particle spectrograph. Values of the transferred neutron angular momenta and of the statistically weighted spectroscopic factors for 20 levels in ^{51}Ti were derived from the measurements by a zero-range distorted-wave Born-approximation analysis. Deuteron optical-model parameters for this analysis were determined by elastic scattering experiments. The results are discussed briefly in terms of the shell model with residual interactions. (auth)

42747 SHOWERS IN LEAD PRODUCED BY ELECTRONS WITH ENERGIES FROM 300 Mev TO 1 Bev. H. Thom (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 136: B447-55(Oct. 26, 1964).

The behavior of electron-initiated showers in a lead-plate expansion cloud chamber was measured for primary energies of 277, 528, 845, and 990 Mev, in terms of the secondary electrons with angles within about 60 deg of the shower axis. Empirical formulas are derived from the experimental data, for characteristic average shower quantities as functions of primary energy. The track length, for example, follows a relation of the form $L_T = 0.073E_0^{0.92}$ radiation lengths, where E_0 is measured in Mev. Expected standard errors in determining energies of individual showers by measuring the various quantities are also given. A new tabulation of the results of Wilson's Monte Carlo calculations is given for primary electrons and photons with energies from 50 to 300 Mev. The average numbers of electrons with energies greater than 8 and 10 Mev correct the originally published curves and are in good agreement with the results of Crawford and Messel. Approximate comparison is made between the experimentally measured shower behavior and the calculated behavior, and good agreement is found. (auth)

42748 VARIATIONAL UPPER AND LOWER BOUNDS FOR MULTICHANNEL SCATTERING. R. Sugar and R. Blankenbecler (Princeton Univ., N. J.). Phys. Rev., 136: B472-91(Oct. 26, 1964).

Upper and lower variational bounds are given for all elements of the reaction matrix. These, in turn, lead to upper and lower bounds on the elastic and inelastic cross sections. Two-particle scattering, coupled two-particle channels, and three-particle scattering situations are discussed, and the methods will work for any number of particles. Numerical examples are given, including phase shift bounds for s-wave electron-hydrogen scattering. It is hoped that this approach will lead to a tractable calculational scheme for strongly interacting relativistic particles. (auth)

42749 SCATTERING RESONANCES AND METASTABLE STATES IN WAVE EQUATIONS. Max Wagner (International Business Machines Corp., Yorktown Heights, N. Y.). Phys. Rev., 136: B562-70(Oct. 26, 1964).

In the neighborhood of scattering resonances, the plane-wave solutions are strongly altered and low-order perturbation theory breaks down. Instead of calculating and using the exact scattering solutions there are many advantages to introducing the quasistationary concept of metastable localized eigenfunctions, by means of which the nonperturbative behavior near resonances can be described, whereas nonlocalized features are given by plane-wave functions. It is shown how metastable eigenfunctions can be defined in a natural way without arbitrariness. It is found that a number of general relations have to be satisfied by the metastable functions, which helps to approximate them in the case of a special problem. (auth)

42750 OBSERVATIONS OF FINE STRUCTURE IN ISOBARIC ANALOG RESONANCES. P. Richard, C. F. Moore, D. Robson, and J. D. Fox (Florida State Univ., Tallahassee). Phys. Rev. Letters, 13: 343a-5a(Sept. 14, 1964).

Two isobaric resonances are observed in ^{92}Mo + p that are analogs of the first and second excited states of ^{93}Mo. The resonances occur at proton energies of 5.3 and 5.9 Mev, and are $\underline{s}$ and $\underline{d}$ wave respectively. A theoretical single-level formula is found inadequate for describing the structure of the excitation functions near the resonance energies. Fine structure having widths on the order of 3 kev is observed in the excitation functions. The nature of the isobaric interactions responsible for the observed structure is discussed. (T.F.H.)

42751 NEUTRON GROUPS FROM O^{16}(γ,n)O^{15}. N. W. Tanner and E. D. Earle (Oxford Univ.). Phys. Rev. Letters, 13: 410-11(Sept. 28, 1964).

Two previous measurements on the neutron group from the ^{16}O(γ,n)^{15}O reaction are compared. It is concluded that the measurements are consistent with transitions to the ground and 6.2-Mev states of ^{15}O only, as predicted by the simple shell model. The branch to the excited states of ^{15}O from the region of ^{16}O between 23 and 26 Mev is about one half. It is possible that the excited-state neutrons have a different resonance structure from the ground-state neutrons. (C.E.S.)

42752 ANALYSIS AND INTERPRETATION OF THE SLOW NEUTRON CROSS SECTIONS OF THE FISSIONABLE NUCLEI. J. E. Lynn (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Rev. Letters, 13: 412-15(Sept. 28, 1964). (AERE-NP/Gen-38)

The interpretation of the resonances in the slow neutron cross sections of fissionable nuclei that is based on the channel theory of fission is discussed. The nuclei ^{233}U, ^{235}U, and ^{239}Pu are considered. It is shown that the experimental data give results that are very different from the expectations of the channel theory of fission. It is suggested that these discrepancies are due to the single-level nature of the analysis of the data. (C.E.S.)

42753 PROPERTIES OF THE ALPHA PARTICLES EMITTED IN THE SPONTANEOUS FISSION OF Cf^{252}. Z. Fraenkel and S. G. Thompson (Univ. of California, Berkeley). Phys. Rev. Letters, 13: 438-41(Oct. 5, 1964).

The angular and energy distributions of alpha particles in the spontaneous fission of ^{252}Cf were measured. The angular distribution was analyzed as a function of the energy ratio of the two fission fragments. (D.C.W.)

42754 ENERGY DEPENDENCE OF LARGE-ANGLE ELASTIC ALPHA SCATTERING FROM Ar^{40}, Ar^{36}, S^{32}, Si^{28}, AND O^{16}. E. T. Boschitz (Lewis Research Center, Cleveland), J. S. Vincent, R. W. Bercaw, and J. R. Priest. Phys. Rev. Letters, 13: 442-4(Oct. 5, 1964).

The angular distributions for alpha elastic scattering by ^{40}Ca, ^{40}Ar, ^{36}Ar, ^{32}S, ^{28}Si, and ^{16}O between 30 and 40 Mev were measured, as well as the excitation functions at angles around 160°. The large-angle cross sections for ^{40}Ca, ^{36}Ar, ^{32}S, ^{28}S, and ^{16}O exhibit pronounced diffraction patterns that have a constant angular position as the incident energy varies between 30 and 40 Mev. ^{40}Ca, ^{36}Ar, and ^{32}S show a strong and systematic energy dependence. A large difference between ^{40}Ar and ^{40}Ca was observed. (D.C.W.)

42755 NEW TWO-NEUTRON PICKUP REACTION: $Mg^{26}(He^4,He^6)Mg^{24}$. M. E. Rickey, H. E. Wegner, and K. W. Jones (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 13: 444-5(Oct. 5, 1964). (BNL-8169)

The energy levels of ^{24}Mg were investigated by measuring the ^6He spectrum and the angular distributions to different ^{24}Mg levels in the $^{26}Mg(^4He,^6He)^{24}Mg$ reaction. The results were compared qualitatively with observations on the $^{26}Mg(p,t)^{24}Mg$ reaction. (D.C.W.)

42756 INFORMATION ABOUT THE TWO-BODY FORCE INSIDE NUCLEI FROM (p,2p) REACTIONS. K. L. Lim and I. E. McCarthy (Univ. of California, Davis). Phys. Rev. Letters, 13: 446-8(Oct. 5, 1964).

The angular distribution for the (p,2p) reaction in which a 1p proton is knocked out of ^{12}C was calculated in the distorted-wave approximation, using a pseudo-potential that fits free (p,p) scattering. The theory underestimated the large-angle contributions coming from high-momentum two-body collisions. Reduction of the one-pion-exchange term of the potential by a factor of two gave better agreement with experiment. An impulse approximation calculation was also performed. (D.C.W.)

42757 SYSTEMATICS OF SOME LEVELS IN EVEN-EVEN NUCLEI. S. Swarnagowri and M. K. Ramaswamy (Karnatak Univ., Dharwar, India). Proc. Indian Acad. Sci., Sect. A, 69: 371-7(June 1964).

A study of the lowest odd-parity states in even-even nuclei has been extended to even-parity odd-spin and odd-parity even-spin states. These states show agreement with the curve $E = 67\ A^{-1/3}$ Mev. (auth)

42758 VERIFICATION OF RAZ'S MODEL FOR VIBRATIONAL EVEN-EVEN NUCLEI. S. Swarnagowri (Karnatak Univ., Dharwar, India). Proc. Indian Acad. Sci., Sect. A, 69: 390-5(June 1964).

The collective model with interparticle interactions included has been used to examine the modifications of the vibrational spectra as the strength of the two-particle interaction and the vibration-particle interaction is varied. The comparison of the experimentally observed energy ratios for ^{48}Ti with the theoretical predictions for D = 1.00 has been extended for other even-even nuclei. Predictions are found to agree with the observed data only for some of the even-even nuclei. (auth)

42759 NUCLEAR POLARIZABILITY, DISPERSION, AND REFLECTION COEFFICIENT NEAR THE MÖSSBAUER LINE. V. V. Khizhnyakov (Inst. of Physics and Astronomy, Tartu). Soviet Phys.-Solid State (English Transl.), 6: 501-2(Aug. 1964). Translated from Fiz. Tverd. Tela, 6: 640-1(Feb. 1964).

Nuclear polarizability, dispersion, and reflection near the phononless absorption line (Mössbauer line) is discussed. A method proposed for detecting the Mössbauer resonance has one advantage over the standard method-weakening of the parasitic background from secondary γ quanta. (P.C.H.)

42760 RESONANCE SCATTERING OF THE 412 kev STATE IN ^{198}Hg. E. Friedland and H. R. Lemmer (Univ. of Pretoria). Tydskr. Natuurwetenskappe, 3: 65-73(1963). (In German)

Resonance scattering of 412-kev photons by ^{198}Hg has been studied by the technique of Doppler broadening of the emission line owing to heating. Observations of the total amount of elastically scattered radiation have been made at an angle of 120° and at source temperatures of 20, 500, 800 and 1100°C. Using the known differential cross sections for Rayleigh and Thomson scattering, the differential cross sections for resonance scattering of the 412-kev quanta have been calculated for the various source temperatures. Taking into account the anisotropy of a 0-2-0 gamma transition and a total internal conversion coefficient $\alpha = 0.044$, the total resonance excitation cross sections of the 412-kev state in ^{198}Hg were calculated. These results were used for the evaluation of the partial gamma width Γ and the mean gamma lifetime τ of the 412 kev level of ^{198}Hg, obtaining the values $\Gamma = (2.15 \pm 0.16) \times 10^{-17}$ erg and $\tau = (4.90 \pm 0.36) \times 10^{-11}$ sec. The experiments also confirmed the assumption that the velocity distribution of the atoms in the source and scatterer is the same as that of the particles of a perfect gas. (auth)

42761 ENERGY LEVELS AND GAMMA TRANSITIONS IN Dy 164. O. W. B. Schult, U. Gruber, B. P. Maier, and F. W. Stanek (Technische Hochschule, Munich and Research Establishment Risø, Roskilde, Denmark). Z. Physik, 180: 298-316(1964). (In German)

The neutron-capture gamma spectrum of ^{164}Dy was measured with a curved-crystal spectrometer. A level scheme was constructed from the energies (30 kev to 1 Mev) and the intensities of the detected lines. The states obtained are: the ground-state rotational band with levels at 73.392 (0.2+), 242.230 (0.4+), and 501.32 kev (0.6+); gamma vibrational levels 761.80 (2.2+), 828.19 (2.3+), 915.98 (2.4+) and 1024.63 kev (2.5+); and a band with K = 2- having the energies 976.88 (2.2-), 1039.30 (2.3-), 1122.76 (2.4-) and 1225.15 kev (2.5-). The precisely determined energies are compared with the collective model. The intensities of the transitions agree with the branching ratios expected from this model. (auth)

42762 ABSORPTION CROSS SECTIONS AND TRANSMISSION COEFFICIENTS FOR PROTONS AND NEUTRONS ACCORDING TO THE OPTICAL MODEL. Heiner Meldner and Albrecht Lindner (Universität, Frankfurt am Main). Z. Physik, 180: 362-8(1964). (In German)

Transmission T_l coefficients and absorption cross sections for protons and neutrons are calculated with optical potentials, which were fitted to experimental scattering data. Values are given for Z = 10, 20, 30, 50, 70, 90 and energies between 0.1 and 25 Mev. For protons, the local optical potential of Perey, was used while for neutrons the nonlocal optical potential of Perey and Buck was used. The results are compared with those of other optical potentials. In addition it is shown, that the spin-orbit-interaction leads to T_{lj} values which sometimes differ appreciably depending on whether j equals $l + \frac{1}{2}$ or $l - \frac{1}{2}$. (auth)

42763 INVESTIGATION OF MAGNESIUM-27 DECAY. Wolfgang Haupt (Universität, Gottingen, Ger.). Z. Physik, 180: 369-74(1964). (In German)

The gamma rays of the decay of ^{27}Mg were investigated using NaI crystals, and gamma-gamma cascades were observed by a fast-slow coincidence circuit. Methods used for exact measurement of the random-coincidence spectrum and stabilization of the multiplier gain are described. The two lines of 808 and 988 kev in coincidence with the 842-kev gamma line and the 817-kev gamma line in coincidence with the 1013-kev gamma line, reported elsewhere, were not observed. If these transitions exist, their intensity would be less than 10^{-3} per decay. (auth)

42764 RELATIVE MEASUREMENTS OF ELECTRON POLARIZATION IN β-DECAY: ^{204}Tl AND ^{32}P. Heinigerd Rebel, Gerd Schatz, and Wolfgang Buehring (Universität, Heidelberg). Z. Physik, 180: 392-409(1964). (In German)

The ratio of the longitudinal polarizations of beta particles from ^{204}Tl and ^{32}P was measured using the method of double scattering. A value of 0.993 ± 0.036 was obtained at 540 kev. The effect of inelastic scattering processes in the source on electron depolarization was estimated. (D.C.W.)

42765 NUCLEAR THEORY INDEX FOR 1963. Booklet No. 3. H. Ogata, ed. (Oak Ridge National Lab., Tenn.). Nuclear Data Project. [1963]. 22p. Washington, D. C., National Academy of Sciences–National Research Council. \$6.00 p.a.(USA); \$7.00 p.a. (other than USA).

References (197) are given for low-energy phenomena in nuclear structure, nuclear reactions, electromagnetic radiation, beta decay and parity, and alpha decay. (R.E.U.)

42766 NUCLEAR THEORY INDEX CUMULATION FOR 1963. Booklet No. 4 Containing Items for 4th Quarter, 1963, and All Items from Booklets Nos. 1, 2, and 3 of 1963. H. Ogata, ed. (Oak Ridge National Lab., Tenn.). Nuclear Data Project. [1963]. 101p. Washington, D. C., National Academy of Sciences–National Research Council. \$2.50.

A listing of 1077 titles is given for references on nuclear structure, nuclear reactions, electromagnetic radiation, beta decay and parity, and alpha decay. An author index is included. (R.E.U.)

42767 NONMESIC DECAYS OF HYPERFRAGMENTS WITH Z ≥ 3 PRODUCED BY K^- CAPTURE IN EMULSION. Monte Wayne Holland. Thesis, Evanston, Ill., Northwestern Univ., 1963. 68p.

Hyperfragments with charge (Z) ≥ 3, produced by K^- capture is an emulsion stack, were studied using production analysis as an aid in hyperfragment identification. On the basis of 96 nonmesic decays and 30 π^- mesic decays, the overall nonmesic to π^- mesic decay ratio was found to be 3.2 ± 7. By separating the events according to production characteristics, the nonmesic to π^- mesic ratios for the $3 \leq Z \leq 4$ group (R_L) and the $Z \geq 5$ group (R_H) were measured. The results were $R_L = 2.4 \pm .7$ and $R_H = 5.3 \pm 1.3$. These results are compared with theoretical calculations made by Dalitz for some selected hyperfragments. The reliability of kinematic analysis of hyperfragment productions was also considered and the charged production pion spectrum was determined. In addition, hyperfragment decay products were examined to study the Λ stimulation process. (Dissertation Abstr., 25: No. 1, 1964)

42768 ENERGY DEPENDENCE OF THE ELASTIC AND INELASTIC SCATTERING OF ALPHA PARTICLES BY C^{12} AND THE $C^{12}(\alpha,p)N^{15}$ (GND.) REACTION. Richard Allen Atneosen. Thesis, Bloomington, Ind., Indiana Univ., 1963. 154p.

Earlier measurements of the 90-degree excitation functions for elastic and inelastic scattering of alpha particles by carbon at bombarding energies from 20.4 to 22.6 Mev showed a more rapid variation with energy than would be expected from simple direct reaction theory. To investigate this behavior further, the alpha-particle beam from the Indiana University cyclotron was used to obtain angular distributions at eight different energies through this range for alpha-particle groups corresponding to elastic scattering and inelastic excitation of ^{12}C to the 4.43-Mev level as well as for the proton group from the (α,p) reaction to the ground state of ^{15}N. In agreement with the earlier work, major changes in the angular distributions are often seen for energy changes of as little as 300 kev. The elastic distribution has a pronounced diffraction structure that varies slowly with bombarding energy at the forward angles but shows anomalous energy-dependent behavior at the backward and central angles. The 4.43-Mev inelastic distribution changes smoothly with energy while going from an oscillatory pattern at the higher energies to a somewhat irregular pattern with a broad valley around 110 degrees at the lowest energy. The (α,p) distribution is characterized at the higher energies by strong peaking at the back angles, at the intermediate energies by an increase in the first maximum, and at the lower energies by peaking at the forward angles and a strong increase in a central maximum. Similar rapid energy-dependent variations are observed at both lower and higher energies. (Dissertation Abstr., 25: No. 1, 1964)

42769 THE DECAY OF IODINE-132 AND E2 CONVERSION COEFFICIENTS IN SAMARIUM-152 AND IODINE-132. Herman Wayne Boyd. Thesis, Nashville, Vanderbilt Univ., 1964. 109p.

The Vanderbilt iron-free double-focusing beta-ray spectrometer was used to investigate the decay of ^{132}I, to measure conversion coefficients of E2 transitions in ^{152}Sm and ^{132}Xe, and to measure L, M, and N photoelectric cross sections in uranium for $h\nu = 122$ kev. A measurement of the conversion electron spectrum below 1.4 Mev in ^{132}Xe from the decay of ^{132}I revealed new transitions at 147.2, 262.8, 504.0, and 507.6 kev. Transitions at 652, 672, and 728.5 kev were confirmed. Other transitions were recorded at 523.0, 772.9, 955.0, 1138.4, and 1399.4 kev. A decay scheme for ^{132}I is proposed. Levels in ^{132}Xe at 1319.9 ± 0.7(2+) and 1827.5 ± 1.3(2) kev were confirmed; new levels at 1991.4 ± 1.0(2), 2110.4 ± 1.0(2?), 3102.8 ± 2.7(3,4,5), ~3210, ~3330 (3,4,5), and ~3550(3,4,5) kev are proposed; and the energies of other known levels were determined to be 667.8 ± 0.3(2+), 1440.7 ± 0.7(4+), 1963.7 ± 0.8(3,4,5), 2070.7 ± 1.1(3,4,5), 2395.4 ± 1.2(4), 2612.5 ± 1.2(3,4,5), and 2840.1 ± 1.7(3,4,5) kev. Spins and parities are indicated in the parentheses. The experimental results could also be consistent with energy levels at 1339.3 and 1847.3 kev instead of these proposed at 1319.9 and 1827.5 kev. The conversion coefficients of the 4+ → 2+ 245-kev transition in ^{152}Sm and the 2+ → 0+ 667.8-kev transition in ^{132}Xe were measured by the internal-external conversion method. The results are $\alpha_K = 0.0818 \pm 0.0090$ and $\alpha_K = (3.59 \pm 0.30) \times 10^{-3}$, respectively. Both of these values are in good agreement with theoretical values for pure E2 conversion coefficients. The L, M, and N photo-electric cross sections for uranium at $h\nu = 122$-kev were measured with 1.12 and 1.52 mg/cm^2 uranium converters. Results obtained are $\tau_L = 360 \pm 40$ b/atom, $\tau_{L_I + L_{II}}/\tau_{L_{III}} = 3.1 \pm 0.35$, $\tau_L/\tau_M = 4.55 \pm 0.55$, and $\tau_M/\tau_{N+\ldots} = 2.5 \pm 0.3$. The τ_L value is higher than that predicted from τ_K when the τ_K/τ_L ratio is assumed to be energy independent. The $\tau_{L_I + L_{II}}/\tau_{L_{III}}$ and $\tau_M/\tau_{N+\ldots}$ ratios are in agreement with other results. (Dissertation Abstr., 25: No.1, 1964)

42770 FOUNDATIONS OF THE NUCLEAR SHELL MODEL. Baird Holmes Brandow. Thesis, Ithaca, N. Y., Cornell Univ., 1964. 237p.

Closed-shell nuclei are treated by means of a Goldstone expansion based on the unperturbed Hamiltonian $H_0 = T + V_{SM}$. The shell-model potential, V_{SM}, is to be determined self-consistently, as in the Brueckner, Gammel, Weitzner (BGW) formulation. The reference-spectrum method of Bethe, Brandow, and Petschek is used to obtain a relatively simple and accurate approximation to the matrix elements $\langle mn|G|mn-nm\rangle$ between a pair of shell-model orbitals. This method permits the starting energy $(E_m + E_n)$ of the particular interacting pair to be treated exactly. For each partial-wave, the result is expressed as an effective interaction, $g_L(r,\vec{R})$, which is local but highly state-dependent, and which reflects the short-range character of the correlations by rapidly approaching the form of the true two-body interaction v. The task of projecting out the various partial waves requires that the complete effective interaction be non-local in the angular part of the relative coordinate: $v(\vec{r}) \rightarrow \langle\hat{r}|g(r,\vec{R})|\hat{r}'\rangle$. The shell-model potential is obtained by examining higher-order terms in the Goldstone expansion for the total wave function. Contributions to V_{SM} from first, second, and third-order insertions are discussed. The lowest-order term is the same as in Hartree-Fock theory, except that v is replaced by the effective interaction g. The name "saturation potential" is used to denote the remaining terms in V_{SM}. Simple estimates indicate that the saturation potential is much more repulsive than the corresponding expressions used by Brueckner's group. These concepts can be extended to nuclei with unfilled shells by means of the Bloch-Horowitz expansion. Elementary derivations, along the lines originally proposed by Brueckner, are presented for both the Goldstone and Bloch-Horowitz expansions, as well as a useful simplification of the latter. Linked-cluster expansions for the wave functions and expectation values are also given. Possible applications of this formalism are discussed. (A.G.W.)

42771 GAMMA-GAMMA DIRECTIONAL CORRELATION STUDY OF BARIUM-134. Lamar William Coleman. Thesis, Corvallis, Ore., Oregon State Univ., 1964. 114p.

Gamma-gamma directional correlations were measured in ^{134}Ba at ten angles between 90 and 180 degrees in ten-degree increments using a scintillation spectrometer. ^{134}Cs decays by beta emission to form several excited states below 2 Mev in ^{134}Ba, which subsequently decay to the ground state by the emission of gamma rays. Two correlation measurements were performed in ^{134}Ba. The first consists of the 797 kev-605 kev, 802 kev-563 kev, 569 kev-797 kev, and the 802 kev-[563 kev]-605 kev correlations. The second contains the 797 kev-605 kev and the 802 kev-[563 kev]-605 kev correlations. The experimental correlation coefficients are consistent with angular momentum assignments of 2, 2, 4, 4 to the 605-kev, 1168-kev, 1401-kev, and 1970-kev excited states respectively. These states are assumed to have positive parity. An analysis of the data in terms of the electric quadrupole to magnetic dipole mixing ratios of the 569-kev and the 563-kev radiations reveals that, within the limits of experimental error, each radiation contains at least a 50 percent magnetic dipole admixture. The other gamma rays involved are assumed to be essentially pure electric quadrupole. This result contradicts the asymmetric rotor model of the nucleus. (Dissertation Abstr., 25: No. 1, 1964)

42772 A MAGNETIC LENS SPECTROMETER FOR ELECTRON-ELECTRON AND ELECTRON-GAMMA DIRECTIONAL CORRELATION STUDIES WITH APPLICATIONS TO Hg^{203}, Au^{198}, AND Tm^{170}. Walter Lawrence Croft. Thesis, Nashville, Vanderbilt Univ., 1964. 167p.

A magnetic-lens spectrometer for electron-electron and electron-gamma directional-correlation studies was constructed. Experiments with electrons up to about 1.7 Mev are possible with the present lens cooling-system. The generator is capable of supplying current to focus 5-Mev electrons. The instrument can be used for resolutions from about 2-6%, and the maximum transmission is about 1.5%. The K conversion-coefficient of the 279-kev transition in ^{203}Tl was measured with a coincidence technique to be 0.162 ± 0.003. The differential beta-gamma directional correlation of the intense beta-ray group and the 412-kev transition in ^{198}Au was investigated at low energies. No anomalous effects were found. The correlation falls off smoothly with energy. The E2 K conversion coefficient of the 84.2-kev transition in ^{170}Yb was measured by two independent methods. Values of 1.66 ± 0.11 and 1.52 ± 0.07 were obtained. The particle parameter for the 84.2-kev transition was evaluated from the results of beta-gamma and beta-K-conversion-electron directional-correlation measurements. Internal bremsstrahlung effects were observed in these measurements. The beta-gamma correlation coefficient including the correction for internal bremsstrahlung was $A_2(\beta\gamma) = -0.049 \pm 0.006$, and that with no correction was $A_2(\beta\gamma) = -0.054 \pm 0.007$. The anisotropy measured in the beta-K-conversion-electron directional correlation was $A_{\beta e_K} = -0.140 \pm 0.007$. This corresponds to a directional-correlation coefficient of $A_{2(\beta e_K)} = -0.125 \pm 0.009$. The particle parameter calculated from the internal-bremsstrahlung-corrected, beta-gamma directional correlation coefficient was $b_2 = 2.56 \pm 0.4$ and from the uncorrected data, $b_2 = 2.32 \pm 0.3$. A directional correlation was measured between the L conversion electrons and beta rays. An anisotropy of $A_{\beta e_L} = -0.097 \pm 0.006$ was obtained. This in conjunction with the beta-gamma directional correlation result corrected for internal bremsstrahlung lead to a particle parameter of $b_2(L) = 1.75 \pm 0.25$. (A.G.W.)

42773 ELECTRON BREMSSTRAHLUNG IN SCATTERING BY NUCLEAR MAGNETIC MOMENTS. Patrick James Dowling. Thesis, Bloomington, Ind., Indiana Univ., 1963. 60p.

The cross section for photon emission in the field of a nuclear magnetic dipole is obtained, with dependence on both nuclear and photon polarization explicit. The forward direction, for both electron and photon, is favored. Since the cross section for magnetic scattering depends on q^{-2} (q is the momentum transfer), while the cross section in the Coulomb case varies as q^{-4}, magnetic effects are significant only at high electron energy and large q. Modifications to account for nuclear spin are given, both for polarized and unpolarized nuclear targets. The bremsstrahlung cross section is integrated over the direction of the scattered electron for both polarized and unpolarized nuclei. The latter result is then integrated over the direction of the photon to obtain the energy spectrum of emitted radiation. From the dependence of the cross section on photon polarization, the radiation can be interpreted as a super-position of unpolarized and linearly polarized quanta. Form factors and nuclear recoil are discussed. Finally, elimination of the infrared divergence is considered, and, as for the Coulomb case, leads to a correction to the elastic cross section. (Dissertation Abstr., 25: No. 1, 1964)

42774 PROPERTIES OF EXCITED STATES OF FLUORINE-19. Neil William Gebbie. Thesis, Toronto, Univ. of Toronto, 1963. 185p.

As a result of experiments carried out, spin and parity values of $^5\!/_2^-$ and $^3\!/_2^-$ were assigned to the 1.35- and 1.46-Mev levels of ^{19}F. The multipole mixing parameters for a number of transitions from these levels and the 1.56-Mev level were obtained. It was then possible to calculate the lifetime of the 1.46-Mev level to be $4 \pm 1.5 \times 10^{-4}$ sec. The transition strengths of M^2 for a number of modes of decay from the 1.35-, 1.46-, and 1.56-Mev levels were also calculated. Next, these experimental results were compared with the predictions made for ^{19}F by a number of nuclear models. Both the group theoretical shell model and the unified model were in satisfactory agreement with the observed data. The collective aspects of the nuclear motion, as evidenced by the observed enhanced E2 transitions, were dealt with in both cases by using a large permanent equilibrium deformation of the nucleus, with a band structure based on intrinsic particle states of the deformed nucleus. (Dissertation Abstr., 25: No. 1, 1964)

42775 SHELL MODEL STUDIES OF SOME PROPERTIES OF THE NUCLEI Bi^{208}, Pb^{208}, AND Tl^{208}. Joseph Bennett McGrory. Thesis, Nashville, Vanderbilt Univ., 1964. 96p.

A calculation of the energy-level structure of the nuclides ^{208}Tl and ^{208}Bi is made by means of the shell model of the nucleus. The methods of configuration mixing are used. The nuclear radial wave functions are represented by the radial wave functions of the harmonic oscillator potential throughout the whole study. It is concluded that the tensor force can play a very significant part in shell model studies of odd-odd nuclei, and that considerable care must be exercised in normalizing various sets of potential parameters, since the results seem to be rather sensitive to variations in such normalizations. Pinkston and True have calculated wave functions for the excited states of ^{208}Pb. The theoretical transition rates for beta-decay transitions between the ^{208}Tl ground state wave function determined in the first part of this study and the Pinkston-True wave functions are calculated. As a check on the expected accuracy of these calculations, a calculation of the first-forbidden beta-decay transition between the ground states of ^{207}Tl and ^{207}Pb was made. The calculated rate is 1.2×10^{-3} sec^{-1}, and the experimental rate is 2.4×10^{-3} sec^{-1}. The experimental half-life of the ground state decay of ^{208}Tl is 3.1 minutes, and the theoretical half-life is 5.4 minutes. Fair agreement is obtained for the relative transition rates to the J = 6$^-$, 3.96-Mev, J = 4$^-$, 3.50-Mev, and J = 5$^-$, 3.25-Mev levels of ^{208}Pb. The transition rate to the J = 5$^-$, 3.60-Mev level is low by an order of magnitude. The electromagnetic-transition rates for transitions between some of the excited states of ^{208}Pb are carried out. The results of the M1 transition-rate calculations are of the right order of magnitude, while the results of the E2 transition-rate calculations are low by several orders of magnitude. The relative rates are in poor agreement with experiment. The Pinkston-True wave functions are relatively poor in admixtures of proton states, which explains, partially, the low E2 transition rates. A calculation in which the concept of an effective charge is used is suggested. (A.G.W.)

42776 COMPARISON OF ANGULAR DISTRIBUTIONS OF GAMMA RAYS FROM THE REACTION Pb^{208}(n,n$'\gamma$)Pb^{208} WITH SATCHLER THEORY. Donald Oliver Nellis. Thesis, Austin, Tex., Univ. of Texas, 1964. 66p.

The angular distribution of the 2.61-Mev gamma ray produced by inelastic scattering of neutrons in lead-208 was measured for incident neutron energies of 3.0 and 4.1 Mev. The gamma rays were detected by means of a large two-crystal NaI(Tl) anti-coincidence spectrometer. Conventional time-of-flight techniques were employed to reduce the effects of scattered neutrons. The experimental angular distributions were compared with the theoretical distributions calculated from Satchler's theory based on the statistical model of Hauser and Feshbach. Experimental absolute differential and integrated cross sections were compared with those predicted from Satchler theory and with the experimental values of other researchers. The theoretical angular distribution obtained at 4.1 Mev provided a satisfactory fit to the experimental points. The theoretical distribution at 3.0 Mev, however, predicted an anisotropy approximately 35% larger than that observed experimentally. At 3.0 and 3.5 Mev the experimental differential and integrated cross sections agreed, within the experimental error, with both the theoretical cross sections and the experimental cross sections of other researchers. At 4.1 Mev the experimental cross sections did not agree with the theoretical values or with the experimental values of other workers. (Dissertation Abstr., 25: No. 1, 1964)

42777 THE DECAY OF Ag^{110m} AND THE SHAPES OF THE BETA SPECTRA OF Au^{198} AND Na^{22}. William Barlow Newbolt. Thesis, Nashville, Vanderbilt Univ., 1964. 89p.

The internal conversion spectrum of transitions from the decay of ^{110m}Ag was surveyed. Relative intensities were determined for the following lines of spectrum: 435.7-K, 446.5-K, 616-K, 620-K, 657.7-K, 706.8-K, 706.8-(L + M), 744.3-K, 763.7-K, 763.7-(L + M), 818-K, 884.3-K, 884.3-(L + M), 937.3-(L + M), 1385.0-K. Two of these lines were assigned to transitions in the decay of ^{108m}Ag. They are the 435.7-K and the 616-K. By the internal-external conversion method, the K internal conversion coefficients for three transitions in ^{110}Cd were determined. The results obtained are $\alpha K_{657.7} = (2.67 \pm 0.10) \times 10^{-3}$, $\alpha K_{884.3} = (1.30 \pm 0.05) \times 10^{-3}$, and $\alpha K_{937.3} = (1.17 \pm 0.08) \times 10^{-3}$. A decay scheme is proposed for ^{110m}Ag. The shape of the intense beta group in ^{198}Au, a first-forbidden, non-unique, transition, was measured with the Vanderbilt, iron-free, double focusing spectrometer. The shape factor measured for this spectrum was fitted with a shape factor of the form $C(W) \propto (1 - 0.30W + 0.07W^2)$. The K conversion coefficient for the 412-kev transition in the decay of ^{198}Au was determined by the PBS method. The result is $\alpha K_{412} = (2.86 \pm 0.10) \times 10^{-2}$. The shape of the allowed positron spectrum of ^{22}Na was measured with a source on a backing of 180 μg/cm² Al foil, and with a source on a 20 μg/cm² Zapon backing. The spectrum measured with the source on the thicker backing showed more deviation from allowed shape than the spectra measured with the source on the thinner backing. The shape factor for spectra measured with the source on the thin backing was fitted with a shape factor of the form $C(W) \propto (1 - 0.58W + 0.2W^2)$. (Dissertation Abstr., 25: No. 1, 1964)

42778 NUCLEAR CHARGE DISTRIBUTION IN FISSION: INDEPENDENT YIELDS OF Y^{92}, Y^{93}, Y^{94}, AND Y^{95} FROM THERMAL-NEUTRON FISSION OF U^{235}. Andrew Edward Norris. Thesis, St. Louis, Washington Univ., 1963. 93p.

The independent fractional yield values of ^{92}Y, ^{93}Y, ^{94}Y, and ^{95}Y from the thermal-neutron-induced fission of ^{235}U were measured. The yttrium values were combined with previously reported isobaric krypton fractional-yield values to determine nuclear charge dispersion curves for each of the four mass numbers. The nuclear charge dispersion data obtained were correlated with dispersion data previously reported for mass numbers 91 and 139 through 143. A single Gaussian curve with $\sigma = 0.59 \pm 0.02$ was found to represent well the dispersion data for all ten mass numbers. The fractional yield data in the mass regions where nuclear charge dispersion has been characterized were examined to learn if correlations exist between yields and nuclear composition features. The results showed little if any correlation. The variation of Z_P (value of Z at the curve maximum) with A was determined empirically for the thermal-neutron-induced fission of ^{235}U, and the result was compared with previously reported Z_P functions. One Z_P function was derived empirically from nuclear charge distribution data, and the other was derived from considerations of minimum potential energy in fission. The general trend of the variation showing a greater proton-to-neutron ratio for light fragments than for heavy fragments was followed by both functions. The half-life value of ^{95}Sr was determined to be 32 ± 3 seconds. (Dissertation Abstr., 25: No. 1, 1964)

42779 NUCLEAR RESONANCE FLUORESCENCE IN Si^{28}. Jean Lowe Ryan. Thesis, Blacksburg, Va., Virginia Polytechnic Inst., 1964. 39p.

The doublet level at $E_p = 504$ kev excited in the reaction $^{27}Al(p,\gamma)^{28}Si$ was investigated using a technique of nuclear resonance fluorescence. A silicon absorber was placed in a collimated beam of gamma rays from the reaction. The direction of collimation with reference to the direction of the bombarding protons governs the exact energy of the ground state gammas available for absorption. The energy deficit that appears in emission and absorption is made up by the kinetic energy of the compound nucleus recoiling from the proton bombardment. Variation of the angle between the collimator and the proton beam allows the measurement of the transmission of the absorber as a function of energy. Measurement of the ratio of the number of transmitted ground state gamma rays and of the number of decaying nucleii was accomplished in one counter. The entire spectrum from the reaction was observed at each angle. The number of ground state gammas was stripped from each such spectrum and the number of gammas decaying to excited states thus determined. Thus, the number of ground state gammas was normalized to the number of lower energy gammas. The low cross section of the reaction, the collimation, and absorption all lead to an extremely low counting rate even though a thick target with proton energy just above resonance was used. The resulting transmission versus energy data were fit to a straight line (i.e., no resonant absorption) and a more complicated assumption of some eight closely spaced levels. The straight line fit is considerably poorer but a result of no resonant absorption seems the more likely. (Dissertation Abstr., 25: No. 1, 1964)

42780 ELASTIC SCATTERING OF DEUTERONS FROM COMPLEX NUCLEI AT HIGH ENERGIES. Tatsuro Sawada. Thesis, Los Angeles, Univ. of California, 1964. 167p.

The elastic scattering of deuterons from complex nuclei at high energies was treated by time-independent perturbation theory using the impulse approximation for the deuteron. The formulation was carried out as for a "two-body" problem, and the deuteron-nucleus scattering amplitudes were related to the nucleon-nucleus scattering amplitudes. The effect of simultaneous scattering of the two particles of the deuteron first considered by H. P. Stapp was treated more rigorously. Using the exact nucleon-nucleus scattering amplitudes obtained from nucleon optical potentials, extensive analyses were carried out upon available data at deuteron energies of 94 to 420 Mev for carbon and several other nuclei. It was found that the inclusion of simultaneous scattering greatly improves the results of the simple first order calculations both for the differential cross sections and for the polarizations. It was found possible to obtain reasonable agreement between the theoretical prediction and the experimental data on deuteron scattering using nucleon optical potentials, which also yield reasonable agreement with the nucleon scattering data. First order optical potentials for the deuteron were constructed from nucleon optical potentials. The differential cross sections and polarizations obtained by solving the Schrödinger equation with these first order potentials were found to be intermediate between the results of the first order impulse approximation and those of the calculation which includes simultaneous scattering. The formulation as the two-body problem was compared with the formulation as the many-body problem; the standard treatment of deuteron scattering as a many-body problem does not seem to be valid beyond the first diffraction minimum. (Dissertation Abstr., 25: No. 1, 1964)

42781 IMPROVEMENTS IN BETA SPECTROSCOPY AND THE DECAY OF SAMARIUM-153, DYSPROSIUM-165 AND CESIUM-134. Robert McDill Woods, Jr. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1963. 98p.

Certain improvements in the iron yoke, double-focusing beta spectrometer at the University of Michigan are described. The use of digital computers in beta spectroscopy was explored. A program to perform the usual counting corrections is described. Burson's program for the analysis of continuous beta spectra was tested and found both satisfactory and useful. The beta spectrum of ^{153}Sm (47 hours) was measured. Components were found with endpoints at 807 ± 3 kev (21 ± 2%), 705 ± 5 kev (41 ± 4%), 639 ± 5 kev (32 ± 4%), and 515 ± 25 kev (6 ± 2%). The conversion electron lines were measured. Both the K and L electrons of the sometimes-reported 83-kev transition were observed. The value 3.8 was obtained for α_K for the 103 kev transition. The beta spectrum of ^{165}Dy (2.3 hours) was badly distorted due to source self-scattering. The upper endpoint is found to be 1290 ± 10 kev. The previously reported beta component in ^{134}Cs (2 years) at 886 kev was searched for. If present, its intensity is less than 0.1%. Relative gamma ray intensities for ^{165}Dy and ^{134}Cs and conversion electron data for ^{134}Cs are also presented. (Dissertation Abstr., 25: No. 1, 1964)

42782 SURFACE AND NONLOCAL CORRECTIONS TO THE HIGH-ENERGY OPTICAL MODEL POTENTIAL. Robert Earl Schenter. Thesis, Boulder, Colo., Univ. of Colorado, 1963. 199p.

The optical potential for the scattering of high-energy nucleons by nuclei is derived under the impulse and multiple-scattering approximations. Additional approximations previously made, which involve neglecting the momenta of the target nucleons with respect to that of the incident nucleon and neglecting the momentum-transfer and energy-dependence of the nucleon-nucleon scattering matrix, are not made, and an exact expression is obtained for the optical potential in momentum space under the impulse and multiple-scattering approximations. When account is taken of the momenta of the target nucleons and the energy-dependence of the nucleon-nucleon scattering matrix, additional contributions to the usual optical potential in configuration space are obtained, which contain non-local terms and terms which depend upon derivatives of the nucleon density function of the target nucleus; the latter terms are primarily surface corrections to the usual optical potential. Consideration of the dependence of the nucleon-nucleon scattering matrix on momentum transfer results in additional surface corrections, which lead to an optical potential characterized by radial functions that have larger mean radii and more diffuse surfaces than does the nucleon distribution in the target nucleus. These momentum-transfer corrections were studied in some detail. It was found that they lead to an improvement in the agreement between the derived and phenomenological optical potentials. (Dissertation Abstr., 25: No. 1, 1964)

42783 NUCLEAR STRUCTURE STUDIES IN TELLURIUM ISOTOPES WITH (d,p) AND (d,t) REACTIONS. R. K. Jolly (Univ. of Pittsburgh). 56p. (CONF-452-49)

From American Physical Society, Washington, D. C., Apr. 1964.

Shell model states in the isotopes 123, 124, 125, 126, 127, 129, and 131 of Te were investigated via (d,p) and (d,t) reactions with a typical resolution of 40 kev. D.W.B.A. calculations were used for the identification of the orbital angular momentum of the captured neutron in (d,p) reactions. The $11/2^-$, $3/2^+$, and $1/2^+$ neutron subshells in the 50-82 neutron shell are found to be filling in these isotopes, although, the $3/2^+$ and $1/2^+$ subshells are not filling as rapidly as would normally be expected. Some indication of the $1/2^-$ and the $3/2^-$ subshells was also found from the next major shell filling in the heaviest isotopes. The $3/2^+$ single particle state was found to lie the lowest in the isotopes 131 and 129, while $11/2^-$ and $1/2^+$ were found to lie the lowest in the isotopes 127 and 125, respectively. Single particle energies were calculated using pairing theory. (auth)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 42295 and 42883.

42784 (AD-439831) INTERACTION OF ELECTROMAGNETIC WAVES AND CLASSICAL PLASMAS. Interim Engineering Report No. 1. (Elcon Lab., Inc., Watertown, Mass.). Aug. 26, 1963. Contract AF33(657)-11671. 110p. (R-8-63-4)

The crossed-beam, cross modulation microwave plasma diagnostic technique is examined on the basis of average electron theory. One microwave beam is used to heat a selected portion of a plasma. This beam is amplitude modulated and produces a modulation of the plasma conductivity. A second steady beam is directed through the plasma and as a result of the heating produced by the first beam is modulated. The resulting signal is dependent only on the properties of the plasma in the region of intersection of the two beams. Tables of propagation constant versus electron density and collision frequency were prepared and expressions for the differential propagation constant were derived. Several methods for making an unambiguous determination of the electron density and collision frequency are outlined. Various detection schemes and bridge arrangements are examined. A heterodyne detector with a large dynamic range appears necessary for successful measurement of the cross modulation. (auth)

42785 (AD-600531) INVESTIGATION OF MAGNETICALLY INDUCED IONIZATION. Semi-annual Technical Summary Report, November 1, 1963–April 30, 1964. (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Contract Nonr 3867(00). 44p.

Three modes of magnetically induced ionization were observed in xenon, depending on whether the initial conductivity was electron-atom or electron-ion collision dominated. A study of the effect of impurities on the ionization rate in xenon shock waves was undertaken. It was observed that diatomic impurities as low as 100 ppm can significantly increase the ionization rate and that the ionization is due to the electronic excitation of low-lying molecular states. (auth)

42786 (AEDC-TDR-64-107) STUDY OF ELECTRODE ATTACHMENT REGIONS IN HIGH-CURRENT GASEOUS DISCHARGES. Gordon L. Cann and Robert L. Harder (Electro-Optical Systems, Inc., Pasadena, Calif.). Aug. 1964. Contract AF40(600)-987. 66p. (AD-603342)

Experimental and theoretical studies of electrode attachment regions in high-current gaseous discharges, particularly in the mechanisms causing retrograde motion of arc attachment spots on the cathode, are reported. Work included mathematical analysis and formulation of a theory of cathode emission under these operating conditions and experimental investigations to correlate the theory with observed effects. Experiments and apparatus for measuring power loss to arc cathodes were set up. Analysis of the retrograde motion of the cathode spot was made, and experiments to confirm the analysis were performed. Study results were used in the definition of a mathematical problem. The MHD equations must be solved in the electrode and in the gas, and the two solutions matched at the interface. (auth)

42787 (ARL-64-43) HEATING AND IONIZATION OF A GAS STREAM BY REPETITIVE, SUPPRESSED-BREAKDOWN DISCHARGES. H. C. Early and F. J. Martin (Michigan. Univ., Ann Arbor). Jan. 1964. Contract AF33(616)-7243. 27p. (AD-601048)

When an impulse voltage having a very fast rise-time is applied to corona-type electrodes, a current of several thousand amperes may flow through the gas before appreciable spark-streamer formation takes place. If the voltage is quickly removed, several joules of energy can be delivered to an atmospheric-density gas in a single suppressed-breakdown pulse. By using pulse repetition rates of several thousand per second, many kilowatts of electrical power can be delivered to a subsonic or supersonic gas stream by a single set of electrodes. Compared to arc-heating methods, the pulsed-corona discharge is diffuse and uniform and the gas flow remains much more homogeneous. (auth)

42788 (CLM-R-38) PLASMA IN MIRROR MACHINES. A. H. Morton (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). June 1964. 49p.

The behavior of plasma in mirror machines has been, so far, determined by the instabilities that develop and, in the case of high-energy ion injection devices, the occurrence of space charge potential. Steady state plasma waves out of which instabilities grow, as well as the theoretically predicted instabilities themselves, are discussed. Experimental results presented show limited agreement with theory. Some comments are made on space charge and plasma build-up in high-energy injection devices. The Culham Laboratory Resonance Trapping Mirror Machine is described, and its plasma behavior anticipated. (auth)

42789 (D1-82-0356) THEORY OF PINCH EFFECT IN ELECTRON-HOLE PLASMAS. James E. Drummond and Betsy Ancker-Johnson (Boeing Scientific Research Labs., Seattle). May 1964. 14p.

An electron-hole plasma initially injected into a semiconductor at current-carrying contacts is compressed by its self-produced magnetic field. Extremely large power densities occur on the axis of such pinched plasmas. This causes rapid heating of the lattice and plasma within the pinch channel. Analog computer studies were used to follow the thermal ionization on the axis of the pinch as well as the concentration of plasma ejected from the inner region by pressure unbalance. The concentration of ejected particles rapidly builds up to exceed even that produced directly by the rising temperature on the axis. Accompanying the increase in the number of carriers is a large decrease in the voltage necessary to sustain constant current through the sample. The lower voltage reduces heat production on the axis, which causes a re-adjustment of temperature and of the number of carriers producing a slight voltage rise. Thus the small voltage rise that was attributed previously to the onset of pinching is seen to occur with the establishment of an equilibrium hollow pinch. Such a magnetothermal pinch occurs when the plasma is dissipating moderate power, namely in InSb between 0.4 kw/cm, the upper limit for magnetic pinching, and ~2 kw/cm, the lower level at which overstable thermal pinching begins. (auth)

42790 (EUR-1805.e) KINETIC EQUATIONS FOR PLASMAS. P. P. J. M. Schram (Institut fur Plasmaphysik, G.m.b.H., Garching, Germany). 1964. 65p.

A review is given of the theory dealing with the derivation of kinetic equations. The advantages of the procedure of Sandri based on the concept of multiple time scales are expounded in the case of weakly coupled and long range homogeneous systems. The influence of an external homogeneous magnetic field is discussed in great detail. Although collective effects are not taken into account, the collision integral converges. A new contribution to the collision integral is found. A general expression for the Fourier transform of the radial distribution function outside thermal equilibrium, $G(\hat{\kappa})$ is found by several methods. The results for small κ introduce limitations on the behavior of the velocity distribution for large velocities. A new derivation of the virial theorem is given. (auth)

42791 (EUR-1850.e(p.61-5)) EURATOM AND THERMONUCLEAR RESEARCH. C. Fairclough and D. Palumbo (European Atomic Energy Community).

A summary of the main developments of thermonuclear research in EURATOM laboratories is presented. It is noted that most of the research is contracted to laboratories in the member states. Five of these contracts are reviewed. (J.R.D.)

42792 (GA-5581) THE ELECTRON CYCLOTRON INSTABILITY. E. G. Harris (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Aug. 11, 1964. 23p.

In earlier experiments it was found that an unstable oscillation near the lth harmonic of the electron cyclotron frequency would occur if $\omega p > l\omega c$ where ωp is plasma frequency and ωc is the cyclotron frequency. Criteria are examined for the appearance of the lth harmonic to be used in determining whether or not the instability is responsible for the observed radiation of harmonics. (J.R.D.)

42793 (ORNL-P-278) ION SOURCE AND COLUMN PERFORMANCE AT ORNL. G G. Kelley and O. B. Morgan (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 14p. (CONF-680-1)

From Linear Accelerator Conference, Stoughton, Wis., July 1964.

The performance of the duoplasmatron ion source for DCX-2 is reported. (R.E.U.)

42794 (R64SD-41) NON-EQUILIBRIUM RADIATION. John L. Kulander (General Electric Co. Missile and Space Vehicle Dept., Burlington, Vt.). June 1964. 110p.

The criteria specifying the conditions for which a gas will be in a state of local thermodynamic equilibrium are discussed for both collisionally and radiatively controlled transition processes. Particular emphasis is given to the radiation field in a gas where the particle translational distribution functions are Maxwellian. A microscopic formulation of the transfer equation and solution for the source function is presented for a general n-level atom where the first resonance line is optically non-thin. Specific solutions are given for a 3-level atomic model. The calculation of the radiative and collisional cross-sections and transition rates is discussed. The bound-bound and bound-free rates are calculated for the lower lying states of NI-VII assuming equilibrium distribution functions for temperatures between 10^4 and 10^6°K. The electron densities and temperatures for which the various collisional and radiative rates are balanced are presented as an indication of situations where the gas (N) will not be in a state of local thermodynamic equilibrium. (auth)

42795 (SCTM-93-63(71)) LECTURES ON PLASMA PHYSICS AND MAGNETOGASDYNAMICS. K. J. Touryan (Sandia Lab., Albuquerque, N. Mex.). June 1963. Contract AT(29-1)-789. 73p.

Separate abstracts were prepared for each of the five lectures. Lecture I is a study of collision processes in an ionized gaseous medium with emphasis on fundamentals. Lecture II considers the interaction of electromagnetic fields with conducting fluids, such as a plasma. Lecture III is an engineering evaluation of these interactions with stress on heat transfer reduction as a possible application. Lectures IV and V consider measurement techniques and diagnostics of plasmas in general. (auth)

For abstracts of individual papers see: 42796, 42797, 42798, 42799, and 42800.

42796 (SCTM-93-63(71)(p.6-12)) FUNDAMENTAL PROCESSES IN IONIZED GASES. G. E. Reis (Sandia Lab., Albuquerque, N. Mex.).

Collision processes resulting in singly ionized particles in a plasma are described. The screening of the ions by electrons and a cloud phenomena called plasma oscillation are discussed. The effects of external electric or magnetic fields on the plasma were also considered. (R.E.U.)

42797 (SCTM-93-63(71)(p.13-22)) FUNDAMENTALS OF MAGNETOGASDYNAMICS. K. J. Touryan (Sandia Lab., Albuquerque, N. Mex.).

The equations governing the flow of a compressible viscous fluid are presented for a plasma in an electromagnetic flow field. Various vector quantities are derived assuming the field vectors of the continuous media (plasma) to be finite and continuous. (R.E.U.)

42798 (SCTM-93-63(71)(p.23-43)) APPLICATIONS OF MAGNETOGASDYNAMICS. W. B. Brooks (Sandia Lab., Albuquerque, N. Mex.).

Some limitations of the standard MHD equations are discussed, as possible engineering applications of MHD are described. (R.E.U.)

42799 (SCTM-93-63(71)(p.44-54)) PLASMA DIAGNOSTICS. I. SPECTROSCOPY. K. L. Shipley (Sandia Lab., Albuquerque, N. Mex.).

The advantages of using spectrographic techniques in plasma diagnostics are discussed. Some data obtainable from spectroscopy of a plasma are described. (R.E.U.)

42800 (SCTM-93-63(71)(p.55-73)) PLASMA DIAGNOSTICS. II. JET OPERATION, MICROWAVE TECHNIQUES, AND LANGMUIR PROBES. F. Schelby (Sandia Lab., Albuquerque, N. Mex.).

Theoretical considerations for plasma diagnostics using microwave and Langmuir-probe techniques are presented. The production and maintenance of plasma jets are discussed. (R.E.U.)

42801 (SEL-64-003) A MODEL FOKKER-PLANCK EQUATION FOR A PLASMA AND ITS SOLUTION. J. P. Dougherty (Stanford Univ., Calif. Radioscience Lab.). [1964]. 36p. (NASA-CR-53200; N64-17584).

A model Fokker-Planck equation is discussed for a single species of particles in a plasma. This equation has several properties in common with the real equation, and ascribes an approximately correct behavior to most of the particles, though it is incorrect for the high-energy tail in the thermal distribution. It is shown that the equation can be solved completely for the small perturbations of a uniform plasma by an electric field harmonic in space and time in an external magnetic field. Applications to ionospheric radar scattering are briefly discussed; it is shown that in certain circumstances ion–ion collisions can have a profound effect on the scattering, even though the collision frequency is much smaller than the ion gyrofrequency. (auth)

42802 (SU-ML-1202) STUDIES OF PLASMA OSCILLATIONS. Quarterly Status Report No. 18, March 1, 1964–May 31, 1964. (Stanford Univ., Calif. Microwave Lab.). July 1964. Contract AT(04-3)-326. 27p.

Activities in a program to determine the mechanisms for growth of instabilities and oscillations in gaseous discharges are reported. The action of sheaths and wave interactions with particles in the discharge are emphasized. Theoretical and experimental work designed to elucidate specific points arising from previous investigations is described. Discussions of beam–plasma interactions, and ion waves are included. (J.R.D.)

42803 (SURI-EE-1063-6402) A STUDY OF THE INTERACTION OF PLASMAS WITH HIGH-INTENSITY R-F FIELDS. Final Report, February 1, 1963–February 1, 1964. Roger F. Harrington, R. R. Gupta, and Peter Stark (Syracuse Univ., N. Y. Research Inst.). Contract AF-AFOSR-423-63. 38p.

The behavior of plasmas in high-intensity r-f fields, both with and without coincident d-c magnetic fields is investigated. Of primary interest is the electromagnetic force density produced by the fields on the plasma. A first-order theory of such forces exists that is valid for high frequencies, low-intensity fields, and low-density plasmas. A general treatment of the theory is extremely difficult because of the nonlinear nature of the equations. An experimental and theoretical investigation of the general problem was undertaken to provide additional data needed before these forces can be intelligently exploited for engineering uses. Work is described in which a general-purpose vacuum system was constructed, microwave test procedures for plasma-filled cavities were developed, and preliminary experiments on plasma-filled cavities were made. Concurrently with the experimental program, a continuing theoretical attack on the general problem was made. The first-order treatment of force distributions in plasmas is extended to the case of nonuniform d-c magnetic fields and a general treatment of methods of determining resonances of cavities filled with materials characterized by gyrotropic permittivity tensors is given. The exact solution was not obtained, but both variational and perturbational approximations were investigated. A proposed method of determining electron density profiles within the resonant cavity is presented. A perturbational procedure was used, but it is not yet known whether the approximations are justified or if the experimental measurements can be made accurately enough. (auth)

42804 (TID-21127) THE USE OF ATOMIC BEAMS AS A PROBE FOR STUDYING LOW-DENSITY PLASMAS. Quarterly Progress Report. (New York Univ., New York. School of Engineering and Science). Aug. 31, 1964. Contract AT(30-1)-2397. 8p.

An experimental setup designed for the use of atomic beams as probes for analyzing plasmas is described. (N.W.R.)

42805 A TECHNIQUE FOR THE EXPERIMENTAL DETERMINATION OF THE ELECTRICAL CONDUCTIVITY OF PLASMAS. Donald D. Hollister (Philco Corp., Newport Beach, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1568-71(Sept. 1964).

A technique is described by which the electric conductivity of a plasma can be measured by observing a diminution of r-f magnetic flux through the plasma. The operational theory of a device using the technique is outlined, and a determination of the conductivity of the exhaust gas of a deflagrating sample of solid rocket fuel expanding in a vacuum is described. (D.C.W.)

42806 APPROXIMATE THEORETICAL CALCULATION OF CONTINUUM OPACITIES. S. S. Penner and M. Thomas (California Inst. of Tech., Pasadena). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1572-5(Sept. 1964).

An approximate procedure is described for the theoretical calculation of the spectral absorption coefficient produced by bound-free and free-free transitions in plasmas containing polyelectronic atoms and ions. The method is based on the assumption that only two ionized species make important contributions to the opacity and that these two ionic constituents are present in equal concentrations. The approximate formulas are shown to yield results that are in good accord with estimates based on detailed numerical computations for nitrogen. (auth)

42807 DISPERSION RELATIONS AND LANDAU DAMPING FOR TRANSVERSE AND LONGITUDINAL ALFVÉN WAVES PROPAGATING THROUGH A GAS OF INFINITE CONDUCTIVITY. F. Winterberg (Univ. of Nevada, Reno). Ann. Phys. (N. Y.), 29: 259-81(Sept. 1964).

A simplified model for low-frequency plasma waves without collisions is studied, in which the contribution of the electrons is described phenomenologically by Ohm's law for infinite conductivity. The ions are described by a Boltzmann-Vlasov equation for which the force density is simply given by the body force $(1/c)j \times H$. This model corresponds essentially to a gas possessing an infinite electrical conductivity. Dispersion relations and expressions for the Landau damping are derived in this model for longitudinal and transverse hydromagnetic waves, which propagate parallel and perpendicular to the lines of force. Two of the wave modes which were found, can be identified as transverse and longitudinal Alfvén waves. In addition, other modes were found which have certain similarities with viscosity-shear and temperature waves well known from classical fluid dynamics. Viscosity-shear and temperature waves in classical fluid dynamics arise from dissipative forces. It is conceivable to assume that the Landau damping mechanism also is connected with certain dissipative forces and therefore gives rise to other wave modes which, however, cannot be derived from classical fluid dynamics. (auth)

42808 ELECTROSTATIC OSCILLATIONS IN HOMOGENEOUS COLD PLASMAS. E. M. Barston (Stanford Univ., Calif.). Ann. Phys. (N. Y.), 29: 282-303(Sept. 1964).

A theoretical investigation of small-amplitude electrostatic oscillations in cold inhomogeneous plasmas is presented. It is demonstrated that for those systems possessing continuous nonconstant unperturbed electron-ion densities, a Fourier or normal-mode analysis in time leads in general to singular modes and a continuous frequency spectrum. Well-behaved solutions to the linearized partial differential equations describing the system are obtained by taking a Fourier integral superposition (inverse Fourier transform) of the singular modes over their continuous spectrum. (auth)

42809 DIRECT RADIATION FROM BEAM-PLASMA OSCILLATIONS. J. Allison and G. S. Kino (Stanford Univ., Calif.). Appl. Phys. Letters, 5: 129-30(Oct. 1, 1964).

A previously described beam-plasma oscillator in which two beams are passed in opposite directions through a plasma is discussed. Oscillations occur in this device just below the plasma frequency; consequently direct radiation of the fundamental r-f frequency would not be expected. A similar experiment is described which indicates that if the oscillation amplitude is great enough, nonlinear effects can give rise to a signal at the second harmonic of the fundamental oscillation frequency. It would appear that as the second harmonic frequency is greater than the plasma frequency it can radiate directly. (C.E.S.)

42810 OHMIC HEATING AND ELECTRIC CONDUCTIVITY OF PLASMA IN STRONG ELECTRIC FIELDS. V. A. Suprunenko, E. A. Sukhomlinov, and N. I. Reva. At. Energ. (USSR), 17: 83-8(Aug. 1964). (In Russian)

A detailed study is made of the instabilities associated with the excitation in plasma of electron oscillations at large electric fields. The picture of the phenomenon obtained agrees qualitatively with theoretical predictions. (tr-auth)

42811 TURBULENT PLASMA CONDUCTIVITY IN MAGNETOHYDRODYNAMIC APPROXIMATION. V. M. Eleonskii and Yu. Ya. Polyak. At. Energ. (USSR), 17: 141-2(Aug. 1964). (In Russian)

The effect of the movement of plasma on its conductivity in the presence of random inhomogeneities is considered. The Herring method in the magnetohydrodynamic approximation is used to determine the effect of parameters for interactions of current and magnetic field on the macroscopic conductivity of a plasma in the prescribed turbulent conditions. The described method may be used to find the dielectric permeability tensor of a turbulent medium. (M.J.T.)

42812 VARIABILITY PROBLEMS ON THE ACCELERATION OF GAS IN STRONG ELECTROMAGNETIC FIELDS. G. M. Bam-Zelikovich. Ivz. Akad. Nauk SSSR, Mekhan. i Mashinostr., No. 3, 9-15(May-June 1964). (In Russian)

An analysis was made of a variation problem in plasma acceleration in crossed magnetic and electric fields when the electromagnetic forces are much larger than the pressure forces. Calculations of maximum velocity and efficiency are also analyzed. Optimum parameters are correlated with parameters for plasma flow in a constant cross section channel with fixed magnetic and electric fields. (R.V.J.)

42813 INVESTIGATION OF PLASMA BOUNDARIES WITH ELECTROMAGNETIC SURFACE WAVES. H. W. Wassink and A. J. Estin (National Bureau of Standards, Boulder, Colo.). J. Appl. Phys., 35: 2795-2800(Oct. 1964).

A microwave surface wave technique using the container boundary as a propagating surface is described with which inhomogeneities in the electron density of a plasma can be studied. Under the assumption that the plasma is azimuthally symmetric and axially uniform, perturbation relations for the microwave field permit an integral transform to convert phase shifts into radial electron density. This technique, applied to a 2-torr, r-f Ne plasma in coaxial geometry, indicates an electron density near the inner wall with a square-law distance dependence. This is not in accord with the well-known theoretical models of diffusion-limited plasmas, but can be explained qualitatively. (auth)

42814 THERMIONIC EMISSION FROM HOT PARTICLES IN A PLASMA. Curtis C. Johnson and C. Kent Bullock (Univ. of Utah, Salt Lake City). J. Appl. Phys., 35: 2804-5(Oct. 1964).

Some plasmas contain condensed species as liquid or solid particles which may be hot enough to emit electrons thermionically into the plasma. The charge and voltage distributions in the vicinity of the particle are determined from the Poisson–Boltzmann equation and from a plasma sheath theory that is modified to account for thermionic emission. There is a critical temperature T_0 at which the sheath changes from an ion sheath to an electron sheath. At temperatures greater than T_0 an electron cloud is injected into the plasma, but it is confined near the particle surface within a distance less than the Debye shielding distance. Some typical voltage and charge density profiles are given for a rocket exhaust plasma. (auth)

42815 MODULATED DIPOLE PLASMA PROBES. L. C. Robinson (Univ. of Sydney). J. Appl. Phys., 35: 2843-5(Oct. 1964).

Plasma density profiles are determined by microwave reflection from a modulated dipole probe. The applications of this method to quiescent plasmas and in other plasma explorations are discussed. (auth)

42816 ELECTROMAGNETIC WAVES IN PARAMETER SPACE FOR FINITE MAGNETOPLASMAS. V. L. Granatstein and S. P. Schlesinger (Columbia Univ., New York). J. Appl. Phys., 35: 2846-55(Oct. 1964).

High-frequency electromagnetic waves guided by an air-bounded, axially magnetized, plasma column of radius a are studied through the technique of parameter space mapping. The parameter space is 3-dimensional with coordinates ω_p/ω, ω_b/ω, and $c/\omega a$. In this 3-space, cutoff and resonance loci form surfaces which enclose approximate domains of existence for various classes of waves. Three wave classes, characterized by distinctive cutoff and resonance surfaces, are identified for a magnetized plasma column, and their relation to waves in a boundless plasma, and on a column of small radius (quasistatic waves) is investigated. Also, evidence is found for the continued existence of the surface wave class into the regime $\omega_b > \omega_p$. Parameter space analysis leads to a determination of salient dispersion characteristics for all wave classes and all order of azimuthal variation by a method contributing to physical insight but which avoids exact but laborious numerical computation. Waves are found which change from forward to backward or vice versa with increasing wave number. (auth)

42817 COMPUTATION OF THE EIGENFREQUENCIES OF NONUNIFORM PLASMAS. A. F. Kuckes (Princeton Univ., N. J.). J. Appl. Phys., 35: 3071-2(Oct. 1964). (MATT-232)

The frequencies of the lowest oscillation modes of a nonuniform plasma confined by a magnetic field were calculated using the Rayleigh-Ritz procedure. The propagation of an electromagnetic wave in a cylindrical waveguide filled with plasma in a longitudinal magnetic field was considered. (D.C.W.)

42818 AN ELECTRON BEAM-PLASMA AMPLIFIER AT MICROWAVE FREQUENCIES. F. L. Ferrari (General Electric Co. Ltd., Wembley, Eng.). J. Electron. Control (1), 17: 49-65(July 1964).

Wave propagation through a cut-off waveguide filled with plasma and immersed in an axial magnetic field is considered, extending some results of Trivelpiece and Gould. Synchronous electron beam interactions with respect to forward waves in this system resulting in the amplification of microwave signals are analyzed theoretically, and an expression for the gain is derived. An experiment is described where an electron beam interacts with the plasma it produces in passing through a metal tube filled with deuterium at ~0.2 torr, a magnetic field ~4 kg being applied. Analysis of the gains recorded at frequencies around 8 gc shows that provided lateral non-uniformity of the plasma distribution is taken into account, the theoretical model used to describe the system is a reasonable one. No effects ascribable to backward wave interactions could be detected. (auth)

42819 COMBINED STARK AND DOPPLER LINE BROADENING. C. Frederick Hansen (General Motors Defense Research Labs., Santa Barbara, Calif.). J. Opt. Soc. Am., 54: 1198-1203(Oct. 1964).

Hydrogen-like line profiles are discussed under conditions where Doppler and Stark broadening are comparable. Approximate methods of folding the profiles are given that reproduce the line height and width. Ion clustering and Debye shielding effects were taken into account by stretching the coordinates so that the line centers occur at the correct frequencies. Electron impact broadening in the far wing was underestimated, but deviations from more exact profiles were generally well within a factor of two in the wings at 1% maximum intensity. Profiles are given for the Lyman α, Balmer α, and Balmer β hydrogen lines. (auth)

42820 ELECTRIC FIELD INTENSITY AT THE SURFACE OF A SOLID IN PLASMA. A. V. Gurevich. Kosmich. Issled., 2: 232-45(Mar.-Apr. 1964). (In Russian)

Studies were made of the charged layer structure at the surface of a solid in a plasma. The electric field intensity at the surface of the solid was determined. The field intensity measurements were used for determining directional ion velocity. (R.V.J.)

42821 THE PLASMA PHYSICS RESEARCH LABORATORY, LAUSANNE. R. Keller. Neue Tech., 6: 202-5 (Aug. 1964).

Research on θ pinch, plasma dynamic stabilization, confinement and heating by high-frequency magnetic fields, and a long-duration, low-pressure arc is described. (M.C.G.)

42822 SOLITARY WAVES IN COLD COLLISIONLESS PLASMA. Paul J. Kellogg (Univ. of Minnesota, Minneapolis and Observatoire de Meudon, France). Phys. Fluids, 7: 1555-71(Oct. 1964).

The propagation of finite amplitude waves in a magnetized plasma, in which thermal motion and collisions are neglected, is studied for arbitrary direction of propagation. Solutions for oblique propagation are presented, which complement the analytical solutions for propagation perpendicular to the magnetic field obtained by Adlam and Allen and others, and for parallel propagation obtained by Saffman. Oblique propagation is much more complicated than the two limiting cases in that: in a given direction and at a given speed higher than the Alfvén speed there are a large number of different waves and as shown by Saffman there are additional waves whose speed is less than the Alfvén speed. These submagnetic waves are investigated in the limit of infinite mass ratio, and the results compared with computer calculations. The stability of the waves against the two-stream instability is investigated and it is shown that the supermagnetic waves (speed higher than Alfvén speed v_A) are destroyed by the two-stream instability unless v_A/c is sufficiently large and the submagnetic waves are destroyed by the two-stream instability unless the pressure is non-negligible. (auth)

42823 TWO-STREAM INSTABILITY IN A COLD INHOMOGENEOUS PLASMA IN A STRONG MAGNETIC FIELD. E. G. Harris (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 7: 1572-7(Oct. 1964). (GA-5072)

The two-stream instability in a cold plasma in a very strong magnetic field is considered. The density distribution is assumed to be the same for all species and varies arbitrarily in directions perpendicular to the field. For a given wavenumber in the direction of streaming there is a discrete set of normal modes. The stability of the system is determined by the lowest eigenvalue of a differential equation. A variational principle is devised for this lowest eigenvalue. The variational principle is applied to Gaussian and exponential density distributions. It is indicated how the eigenvalues corresponding to higher modes may be found by a Wentzel-Kramers-Brillouin method. (auth)

42824 SHEET-CURRENT PLASMA MODEL FOR ION-CYCLOTRON WAVES. Akira Hasegawa and Charles K. Birdsall (Univ. of California, Berkeley). Phys. Fluids, 7: 1590-1600(Oct. 1964).

An approximate plasma model, using current sheets, is introduced and initial results are presented. The primary utility is to obtain the nonlinear behavior of ion-cyclotron waves. Linear analysis is used to develop the bicircular particle motion, to show the coupling of the ion-cyclotron resonance for finite $T_\perp$, to show Landau cyclotron damping for finite $T_{||}$. The sheet model is developed in terms of vector potential A and sheet current density J_z for k parallel to the steady field B_0. There are transverse fields only, with sheet motion along three coordinates. The electrons are assumed to be hot, forming a neutralizing background. The model accuracy tests show a reasonable duplication of cold plasma ion waves. The first computer experiment shows wave damping for $T_{||} \gg T_\perp$ at the rate expected from linear analysis, and with $T_{||}$ decreasing, $T_\perp$ increasing. The second computer experiment shows wave growth for $T_\perp \gg T_{||}$, at the rate expected, and with $T_\perp$ decreasing and $T_{||}$ increasing. The third computer experiment was to find the limit in $T_\perp$ for interaction with an electron stream for $\omega \sim \omega_{ci}$; the nonlinear limit found is equal transverse energies, whereas linear analysis shows an m_e/m_i smaller value. This result is encouraging for using this method for ion heating. (auth)

42825 EXPERIMENTAL INVESTIGATION OF RADIATION FROM AN ARGON PLASMA. R. S. Tankin and J. M. Berry (Northwestern Univ., Evanston, Ill.). Phys. Fluids, 7: 1620-4(Oct. 1964).

A thermistor bolometer was used to measure the radiation from an argon plasma generated in a plasma torch and exhausted into the atmosphere. Pointwise radiation measurements along the centerline of the plasma jet yielded the axial distribution of radiative flux from the jet. Total radiation measurements revealed that up to 18% of the net power input to the plasma is radiated from the plasma jet. Temperature-radiation measurements showed the Kramers-Unsöld theory predicts the temperature dependence of radiation reasonably well. (auth)

42826 NONEXISTENCE OF QUIESCENT PLASMA STATES IN ION PROPULSION. Heinrich Derfler (Stanford Univ., Calif.). Phys. Fluids, 7: 1625-37(Oct. 1964).

The problem of neutralizing an ion beam is analyzed within the framework of a one-dimensional collision-free theory. The character of steady-state solutions obtained depends upon the ratio between the mean thermal speed of the electrons and the ion velocity. When the ions are faster, excess electrons are returned to their source from a finite distance behind the electron emitter and the flow of charges is unidirectional (beam-like) further downstream. When the electrons are faster, a floating target must be postulated downstream to intercept electrons and ions at equal rates and to return excess electrons to the emitter. In this case the flow pattern of the electrons is plasma-like. Both beam-like and plasma-like states are found to be unstable with respect to small perturbations. Thus the plasma driving a space vehicle cannot be in a quiescent state. (auth)

42827 PERFORMANCE STUDIES WITH AN ELECTRICALLY DRIVEN SHOCK TUBE. David W. Koopman (Univ. of Michigan, Ann Arbor). Phys. Fluids, 7: 1651-7(Oct. 1964).

Studies of an electrically driven shock tube employing a coaxial electrode configuration were made to determine the nature of the shock-heated plasma and the suitability of such a shock tube as a source for quantitative spectroscopic measurements. Good agreement was found between the flow velocity measured experimentally and the velocity predicted from a mathematical treatment of the acceleration process. Image converter camera photographs showed that the flow is highly turbulent and irregular, in contrast to expected shock-wave behavior. A graphical procedure was employed to calculate the conditions behind fast shock waves in a 75% He–25% Ne gas mixture at an initial pressure of 1 torr. Time-resolved spectroscopic measurements of plasma conditions demonstrate that the temperature and density are about half those values calculated for the observed shock speed of 5.5 cm/μsec. The measured plasma conditions and the internal consistency of the data indicate that the gas can be described as being in quasi-thermodynamic equilibrium to within 30%. The irregular nature of the flow, however, restricts the usefulness of the device as a spectroscopic source. (auth)

42828 PLASMA ROTATION AND INSTABILITY IN THE θ-PINCH DUE TO TRANSVERSE MAGNETIC FIELDS. Peter C. Thonemann (Culham Lab., Abingdon, Berks, Eng.) and Alan C. Kolb. Phys. Fluids, 7: 1455-61(Sept. 1964).

Plasma rotation in a θ-pinch is analyzed theoretically. The torque on the plasma is assumed to be produced by the interaction of an axial Hall current with a weak transverse magnetic field component normal to the plasma axis. Such a transverse magnetic field is present when multipole fields of Ioffe type are used to prevent radial plasma drift. The Hall currents arise from the interaction of the main θ current with the transverse magnetic field. The problem is simplified by ignoring radial and axial plasma motion and assuming the plasma to be incompressible. The resistive decay of the plasma currents and the distortion of the initial transverse magnetic fields by the Hall currents are shown to be of primary importance in determining the characteristic growth time of rotation and the maximum rotational velocity. The condition for the appearance of flute instabilities as a result of plasma rotation is briefly discussed. (auth)

42829 LONGITUDINAL INSTABILITY IN A SEMI-INFINITE INHOMOGENEOUS PLASMA. L. D. Pearlstein (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 7: 1461-7(Sept. 1964). (GA-4807)

The stability properties of a semi-infinite inhomogeneous electron plasma in a uniform positive background are examined by using the Vlasov approximation. It is assumed that the perfect absorbing plane at $x = 0$ is a cathode emitting electrons. It is shown that equilibrium solutions with an electron excess everywhere in the half plane are stable, whereas those solutions that exhibit a positive space charge are unstable provided the maximum accelerating potential is roughly greater than 5kT. The growth rates are on the order of $(1/2\pi)(4\pi e^2N/m)^{1/2}$. (auth)

42830 MICRO-INSTABILITIES IN MAGNETICALLY CONFINED, INHOMOGENEOUS PLASMA. J. D. Jukes (Culham Lab., Berks, Eng.). Phys. Fluids, 7: 1468-74 (Sept. 1964).

Plasma with a density gradient supported in a strong, nearly uniform magnetic field is liable to resistive, gravitationally (g-) driven instability and short-wave drift instability. Waves associated with both propagate almost perpendicular to the field lines. Only a low g, and low density plasma are considered, for which these flutelike perturbations remain quasi-electrostatic, so that dispersion relations are readily found. When the magnetic-field lines are sheared the localized perturbations that arise are treated by a phase-integral approximation, and growth rates appear as eigenvalues of certain standard equations. The ions are treated throughout by the Vlasov equation so that fine-scale features such as finite ion Larmor radius α_i and Hall current are correctly included. The results for the resistive, gravitational instability are compared with those based on fluid equations, and are valid if the perturbation is not localized within α_i. (auth)

42831 TRAPPING AND LOSS OF CHARGED PARTICLES IN A PERTURBED MAGNETIC FIELD. R. C. Wingerson, T. H. Dupree, and D. J. Rose (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 7: 1475-84 (Sept. 1964).

The properties of a nonadiabatic magnetic system for trapping and confining charged particles are derived. The trapping mechanism is a helical perturbation that matches the gyrations of an incoming particle beam. These particles, in resonance with the structure, convert their axial energy into transverse energy even in the absence of a magnetic mirror. By the same scheme, a spiraling beam could be straightened out. The best injection system is a four-conductor set, which is analyzed in detail. Once confined, the particles experience small and almost random nonadiabatic perturbations in their motion; they diffuse in both real and velocity space. A linear operator that governs this diffusion is presented; it is applicable to a uniform magnetic field with small perturbations. The velocity-space diffusion in a magnetic mirror is calculated for a general perturbation and in particular for a helical perturbation. For this last case, the injected particles can be confined for several hundred axial transits. If the charged particles are modified after being initially trapped (e.g., by dissociation of molecular ions), the loss in physically realizable systems can be made virtually negligible compared with charge transfer and other conventional losses. (auth)

42832 RESONANCE OSCILLATIONS IN A HOT NONUNIFORM PLASMA. J. V. Parker, J. C. Nickel, and R. W. Gould (California Inst. of Tech., Pasadena). Phys. Fluids, 7: 1489-1500(Sept. 1964).

A quantitative theory of resonance oscillations is given. The first two moments of the collisionless Boltzmann equation assuming a scalar pressure are used in conjunction with a physically reasonable radial electron density profile to describe the oscillations of a hot nonuniform plasma cylinder. These equations, coupled with Maxwell's equations assuming a scalar potential, are solved numerically to yield the frequency spectrum of the plasma wave resonances. It is found that the frequency spectrum depends on the parameter $r_w^2/\langle\lambda_d^2\rangle$ where r_w is the radius of the plasma column and $\langle\lambda_d^2\rangle$ is the mean square Debye length of the electron plasma. Experimental observations of dipole and quadrupole spectra for two plasma columns of differing radii are reported, and the results of these observations agree with the theory. The physical mechanism of the resonances is described. (auth)

42833 INFLUENCE OF GYRATION RADIUS AND COLLISIONS ON HYDROMAGNETIC STABILITY. Bruno Coppi (Princeton Univ., N. J.). Phys. Fluids, 7: 1501-16(Sept. 1964). (MATT-218)

The stability of low-pressure equilibrium configurations is analyzed considering regimes where the effects of ion Larmor radius and collisions are important. The theory is based on the asymptotic solution of moment equations derived from the Fokker-Planck equation. Purely growing interchange modes are found with growth rates proportional to $\eta_{||}/\alpha^2$, where $\eta_{||}$ is the longitudinal electrical resistivity and α the ion gyro-radius. The class of modes of this type, which are not localized, and a class of electrostatic and localized modes, are shown to have the same growth rates. Nonlocalized tearing-type modes are found to be overstable and have growth rates proportional to $\eta_{||}/\alpha^{4/3}$. When the ion gyro-radius effects are relatively large, the presence of a resistivity gradient in the equilibrium is shown not to modify tearing modes nor introduce new localized modes because of thermal conductivity along the magnetic field. For all the instabilities mentioned the width of the region where collisional effects are important is dependent on the ion gyro-radius but not on transport coefficients. (auth)

42834 MULTIPLE INSTABILITY IN A PLASMA–BEAM SYSTEM. Jacob Neufeld and Harvel Wright (Oak Ridge National Lab., Tenn.). Phys. Fluids, 7: 1527-34 (Sept. 1964).

A "multiple instability" in a plasma–beam system (when several waves having different frequencies and aligned in the same direction are simultaneously excited) is investigated for a system in which a cold and uniform ionized medium immersed in a static magnetic field B_0 interacts with a beam of protons aligned in the direction of B_0. The excited waves are transverse and move in the direction parallel to B_0. The multiple instability occurs when the velocity of the proton beam is within a definite velocity range. This range is defined in terms of the parameters of the plasma–beam system. There are three transverse waves excited by the beam within the range of multiple instability. If ω', ω'', and ω''' are, respectively, the frequencies of these waves satisfying the inequality $\omega' > \omega'' > \omega'''$, then the corresponding rates of growth $|\text{Im } \delta'|$, $|\text{Im } \delta''|$, and $|\text{Im } \delta'''|$ for these waves satisfy the inequality $|\text{Im } \delta'| < |\text{Im } \delta''| < |\text{Im } \delta'''|$. Thus, the wave having lowest frequency has the largest rate of growth and represents the dominant instability. Using the magnetodynamic approximation, it is shown that $|\text{Im } \delta''|$ increases with the velocity ν of the proton beam until it reaches a maximum for $\nu \approx 0.7c$ (where c designates the velocity of light) and then decreases for $\nu > 0.7c$. Various relationships between the quantities that define a multiple instability and the parameters that describe plasma–beam systems are investigated. (auth)

42835 BEAM-TEMPERATURE EFFECTS ON THE ELECTROSTATIC INSTABILITY FOR AN ELECTRON BEAM PENETRATING A PLASMA. H. E. Singhaus (Stanford Research Inst., Menlo Park, Calif.). Phys. Fluids, 7: 1534-40(Sept. 1964).

The electrostatic instability of an infinite electron beam penetrating an infinite plasma is analyzed. The objective is to determine the effect of beam temperature upon the growth rate of the electrostatic waves (a Gaussian velocity distribution is assumed). In addition, the role of collisions within the plasma is explored. A conclusion of this study is that a high-temperature limit for the beam can be defined in terms of the plasma frequencies of the beam and of the plasma. At the high-temperature limit, the plasma collisions can quench the electrostatic instability; at lower temperatures, collisions tend to enhance the growth rate. The results presented are based upon a numerical analysis of the usual dispersion equation that is obtained for this beam–plasma system. In addition to the numerical results, approximate analytic expressions for the growth rate are derived for a number of cases of interest. (auth)

42836 CONFINEMENT OF A HOT ELECTRON PLASMA IN A MIRROR MACHINE, DECA 1. A. Bariaud, R. Gravier, M. Korman, H. Luc, C. Renaud, and J. Tachon (Euratom and Commissariat à l'Énergie Atomique, Fontenay-aux-Roses, France). Phys. Fluids, 7: 1541-8 (Sept. 1964).

Plasma, produced by a hydrogenated titanium washer gun, was compressed between two pulsed magnetic mirrors (rise time 150 μsec, decay time 6 msec). For weak initial magnetic fields (below 150 G) and large compression ratios (above 100), the resulting plasma consists of very energetic electrons and colder ions; it is confined during several milliseconds. Typically, with an initial field of 30 G antiparallel to a compression field of 10 kG, the compressed plasma has a diameter of 1.5 cm and a length equal to or less than 7 cm; the average hot electron density is $(4 \pm 2) \times 10^{11}$ cm^{-3}, with mean energy of 45 ± 10 kev; the density of the cold plasma, which might be present around the compressed plasma, is less than 10^{11} cm^{-3}. Calculations show moreover that, in addition to the adiabatic heating, an important nonadiabatic acceleration occurs at the beginning of the compression. When the initial density is higher than 10^{13} cm^{-3}, the energetic electrons do not appear. Large radial leaks are observed, which might be caused by an instability. Such conditions correspond to a β that is higher than 1 to 3% for the compressed plasma. (auth)

42837 SYNCHROTRON RADIATION MEASUREMENTS FROM A PLASMA IN A MAGNETIC MIRROR MACHINE. A. J. Lichtenberg (Univ. of California, Berkeley), S. Sesnic, A. W. Trivelpiece, and S. A. Colgate. Phys. Fluids, 7: 1549-51(Sept. 1964).

The synchrotron radiation emanating from a "hot-electron" plasma (kT_e = 50 kev, B = 60 kG) is measured to have a peak value greater than 1.0 mw/sr integrated over the wavelength interval of 0.1 to 4.0 mm. The plasma is confined by a pulsed magnetic mirror field. (T.F.H.)

42838 USE OF THE INDEX OF REFRACTION AS A MEANS FOR STUDY OF PLASMA CONFIGURATIONS. Eric G. Johnson, Jr. (National Bureau of Standards, Boulder, Colo.). Phys. Fluids, 7: 1551-2(Sept. 1964).

Starting from continuity, momentum-balance, and Maxwell's equations, it is shown that the index of refraction and the dielectric constant of a plasma must be regarded as tensor quantities. (T.F.H.)

42839 STABILIZATION OF ELECTRON-HOLE PLASMAS BY A MAGNETIC TRAP. Betsy Ancker-Johnson (Boeing Scientific Research Labs., Seattle). Phys. Fluids, 7: 1553-4(Sept. 1964).

A plasma is produced by electron injection into a bar of InSb that is immersed in a static axial magnetic field. A coil of Cu wire is placed around the InSb bar in such a way as to produce symmetrical end mirrors and quadrupole wall mirrors near the surfaces of the bar. The effects of this Cu coil upon helical instabilities in the electron–hole plasma produced in the InSb are studied. Both d-c and r-f currents through the Cu coil are used. (T.F.H.)

42840 THE DAMPING OF LONGITUDINAL PLASMA WAVES. R. N. Franklin (Oxford Univ.). Phys. Letters, 12: 98-9(Sept. 15, 1964).

The damping of longitudinal plasma waves is calculated, taking into account electron collisions. It is found that although collision damping is effective at pressures on the order of 10^{-1} mm Hg, some other mechanism must intervene at lower pressures, in order to reproduce the observed damping. (T.F.H.)

42841 LIGHT AND SOUND EMISSIONS FROM NONLINEAR PLASMA FLUCTUATIONS. Asim Yildiz (Raytheon Co., Wayland, Mass.). Phys. Rev., 136: A393-404 (Oct. 19, 1964).

Light and sound emissions due to nonlinear fluctuations of an electron-plasma field are investigated from the viewpoint of interaction phenomena. The method of solution is similar to that of a forced-oscillation problem, where the equivalent force term couples the different order of the field amplitudes, and is also responsible for the energy conversion from transverse field to longitudinal and inversely. For the general solution, an nth-order perturbation theory is initiated, based on the equations of the plasma field, and a formal solution for the nth order is derived. Analysis is performed for the lowest order nonlinear fluctuations; radiation field intensities and scattering cross sections for all possible types of interactions are obtained. Furthermore, it is shown that the scattered waves radiate with combination frequencies. (auth)

42842 SPIN EFFECTS OF THE LONG-WAVELENGTH OSCILLATIONS OF A QUANTUM PLASMA IN A MAGNETIC FIELD. Norman J. Horing (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 136: A494-9(Oct. 19, 1964).

The results of earlier work on the quantum theory of electron-gas plasma oscillations in a magnetic field are extended here to take account of the difference in masses associated with the orbital and spin parts of the individual electronic motions in the presence of a lattice, and allowance is made for an anomalous electronic g factor. Tractable expressions for the complete plasmon dispersion relation and damping constant (at arbitrary temperature and arbitrary magnetic field strength), which are obtained using a Green's-function formulation of the random-phase approximation, are reported. The low-wave-number (p) approximation of the dispersion relation is investigated in detail. For p = 0 the usual result obtains, $1/\omega_p^2 = \sin^2\theta/\Omega_0^2 + \cos^2\theta/(\Omega_0^2 - \omega_c^2)$, with two plasma modes; these are shifted to order p^2 by terms that are oscillatory in the de Haas-van Alphen (DHVA) sense in the degenerate case. Another plasma resonance in the vicinity of $2\omega_c$, which is active to order p^2, exhibits such DHVA oscillatory behavior, and the same may be said for a gap in the frequency spectrum for propagation perpendicular to the magnetic field in the interval $[\omega_c, 2\omega_c]$. The relative amplitudes for the plasma modes are reported also. The terms that are oscillatory in the DHVA sense are exhibited in terms of an appropriate Fourier series, with no restriction on temperature or magnetic field strength, save that $\zeta\beta \gg 1$ (that is to say that no restriction is placed on $\hbar\omega_c\beta$). Moreover, the spectral composition of the DHVA oscillatory terms is thereby explicitly shown to be a sensitive function of $g(m/m_0)$, and this result may be useful for the experimental determination of the product of anomalous electronic g factor and effective mass m. A considerable improvement over other recent work on this subject was achieved through a careful and correct determination of the role of the DHVA terms as a whole in the plasma oscillation spectrum. (auth)

42843 REMARKABLE EFFECT OF MANY-PARTICLE COLLISIONS ON TRANSPORT PROPERTIES OF NONDEGENERATE PLASMAS. Setsuo Misawa (Univ. of Sheffield, Eng.). Phys. Rev. Letters, 13: 337a-9a(Sept. 14, 1964).

Taking into account ternary collisions in a nondegenerate plasma within the Born approximation, an expression is found relating the electron mean free path (mfp) in the binary Born approximation to the electron mfp in the ternary Born approximation, in terms of the plasma parameters. The effect of taking this ternary-collision mfp into account is investigated, with respect to the plasma transport properties. (T.F.H.)

42844 MEASUREMENT OF THE SYNCHROTRON RADIATION SPECTRUM FROM A HOT PLASMA. A. J. Lichtenberg, S. Sesnic, and A. W. Trivelpiece (Univ. of California, Berkeley). Phys. Rev. Letters, 13: 387-8 (Sept. 28, 1964).

The spectral distribution of the synchrotron radiation from a hot electron plasma was measured. The plasma was confined in a magnetic-mirror configuration and heated by magnetic compression. The synchrotron radiation measurements were made by means of a far-infrared monochromator with 10% bandwidth followed by an InSb photodetector. The measurements were made at a magnetic field of ~50 kgauss. (C.E.S.)

42845 MULTIRAY DEVICE FOR PLASMA DIAGNOSTICS. V. B. Brodskii, B. M. Belitskii, S. E. Zagik, V. A. Lyutomskii, and A. V. Spiridonov. Pribory i Tekhn. Eksperim., No. 4, 116-19(July-Aug. 1964). (In Russian)

Experimental devices for plasma radiodiagnostics, using focused centimeter and millimeter radio waves, are described. A measurement was obtained of the cross section of a focused beam of radio waves. (tr-auth)

42846 SHIELDED LANGMUIR ION COLLECTION PROBES. G. S. Janes and J. P. Dotson (Avco-Everett Research Lab., Everett, Mass.). Rev. Sci. Instr., 35: 1617-18(Nov. 1964).

A shielded Langmuir ion collection probe that provides a constant effective ion collection area is described. (C.E.S.)

42847 MAGNETIC PROBE RESOLUTION. John H. Malmberg (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Rev. Sci. Instr., 35: 1622-3(Nov. 1964).

Calculations for determining the radius of influence of a magnetic probe tube in a plasma are presented. (C.E.S.)

42848 THE CONTACT SURFACE IN AN ELECTROMAGNETIC SHOCK TUBE. G. D. Cormack (Institut für Plasmaphysik GmbH, Garching, Ger.). Z. Naturforsch., 19a: 934-40(July-Aug. 1964).

An investigation of the luminosity structure, electron density, temperature, and arrival time of electrode material in the shock-heated region of a plasma produced in a T tube disclosed that for the conditions studied the luminosity from this region originates primarily from gases which have passed through the contact surface. A plausible explanation for this mixing of discharge gases with shock-heated gas is discussed. The proposed inertial instability of the contact front is an alternative explanation rather than radiation absorption in the gas ahead of the luminous plasma for the high values of temperature and anomalous values of electron density that have been measured in electromagnetic shock tubes. (auth)

42849 MECHANISM OF TRIGGERED DISCHARGES. H. Zwicker and M. Kaufmann (Technische Hochschule, Hanover). Z. Physik, 180: 255-71(1964). (In German)

The physical mechanisms for eruption of a triggered three-electrode spark gap are discussed and compared quantitatively with experiments. From the results an improved conception of the mechanism was obtained and established by further experiments. The consequences of the formation of spark gaps for shock flow patterns in plasma physics are considered. (tr-auth)

42850 HALL EFFECT IN TWO-DIMENSIONAL FLOW OF IDEALLY CONDUCTING COMPRESSED LIQUID. A. I. Morozov and L. S. Solov'ev. Zh. Tekhn. Fiz., 34: 1141-53 (July 1964). (In Russian)

An analysis was made of plasma flow described by ideal magnetohydrodynamic equations taking into account the Hall effect. A detailed account was made of approximations for a narrow channel and flow with slowly alternating parameters along the flux. (tr-auth)

42851 ACCELERATION OF ROTATING PLASMA IN AXIALLY SYMMETRIC CHANNELS. A. I. Morozov and L. S. Solov'ev. Zh. Tekhn. Fiz., 34: 1154-69(July 1964). (In Russian)

Rotational plasma motion in axially symmetric channels in a longitudinal magnetic field was studied considering ideal plasma conductivity and an absence of dissipative processes. (R.V.J.)

42852 ON THE EXPANSION OF A NEUTRAL PLASMA IN AN EXTERNAL MAGNETIC FIELD. V. I. Kval'vasser and Ya. F. Rutner. Zh. Tekhn. Fiz., 34: 1170-4(July 1964). (In Russian)

A precise analytical solution was found for electromagnetic fields with neutral, unrestricted conducting plasma uniformly expanding from a linear plane source in an external uniform and constant magnetic field. (tr-auth)

42853 CYCLOTRON OSCILLATIONS IN HETEROGENEOUS PLASMA. L. S. Bogdankevich and A. A. Rukhadze (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 34: 1175-82(July 1964). (In Russian)

The shape of magnetically restricted absorption lines of a spatially heterogeneous plasma was investigated. Dispersion equations are obtained for determining heterogeneous plasma oscillations near electron and ion cyclotron frequencies. The dispersion relations obtained were used for determining the plasma layer with parabolic density distribution. (tr-auth)

42854 EXCITATION OF ELECTROMAGNETIC WAVES IN A PLASMA BY AN EXTERNAL CURRENT. V. F. Aleksin and K. N. Stepanov. Zh. Tekhn. Fiz., 34: 1210-23 (July 1964). (In Russian)

Excitation of electromagnetic waves in unrestricted magnetoactive plasma was studied on the basis of kinetic theory. General expressions were obtained for electromagnetic fields produced in plasma by currents, and expressions were developed for the loss of energy. A detailed study was made of wave excitation, modulated in the external field direction, by azimuthal and axial electric currents. (tr-auth)

42855 CYCLOTRON RESONANCE IN A HETEROGENEOUS PLASMA CYLINDER. M. P. Vasil'ev, L. I. Grigor'eva, V. V. Dolgopolov, B. I. Smerdov, K. N. Stepanov, and V. V. Chechkin. Zh. Tekhn. Fiz., 34: 1231-6 (July 1964). (In Russian)

High-frequency heating of a plasma cylinder by external current was investigated under conditions of ion cyclotron resonance in the case in which the plasma density and temperature were functions of the radius. (R.V.J.)

42856 RESONANCE PROBING OF A PLASMA IN A MAGNETIC FIELD. V. G. Davidovskii, L. V. Dubovoi, and A. G. Ponomarenko. Zh. Tekhn. Fiz., 34: 1242-51 (July 1964). (In Russian)

Plasma resonance permits determination of electron concentration in isotropic plasma and indicates the frequency of collisions in relation to $\Delta\omega = \sqrt{3}\nu$. The resonance effects were studied in anisotropic plasma using Hertz dipole excitations. (R.V.J.)

42857 SELF-CONSISTENT METHOD OF HEATING OF PLASMA BY RADIATION FROM OPTICAL GENERA-

TOR. O. N. Krokhin (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 34: 1324-7(July 1964). (In Russian)

It is shown that a self-consistent heating of plasma by radiation from optical generators is possible. (R.V.J.)

42858 ELEMENTS OF PLASMA PHYSICS. Solomon Gartenhaus. New York, Hold, Rinehart and Winston, 1964. 204p.

The theory of the physics of a fully ionized gas is outlined. Maxwell's equations, the motion of a charged particle in given electromagnetic fields, the dynamics of many-particle systems, the Boltzmann-Vlasov equation, magnetohydrodynamics, and plasma oscillations are discussed. (C.E.S.)

42859 RADIAL DISTRIBUTION FUNCTION OF AN ELECTRON GAS. David Don Carley. Thesis, Gainesville, Fla., Univ. of Florida, 1963. 149p.

The problem was to determine the pair spatial correlations among the particles of an electron gas under varying conditions of temperature, density, and particle mass. Radial distribution functions, g, for a classical electron gas were computed using the Percus-Yevick (PY) integral equation, convolution hypernetted chain (CHNC) integral equation, Debye-Hückel (DH) equation, and the Broyles-Sahlin (BS) equation. The quantities $\overline{U}/NkT$ and pV/NkT were computed from these g's ($\overline{U}$, average potential energy; N, number of particles; k, Boltzmann constant; T, absolute temperature; p, pressure; V, volume; ϵ, particle charge). Computations covered a range of θ from 0.2 to 20.0; $\theta = kTa/^2$ where $\underline{a}$ is the ion sphere radius $(a = 3V/4\ N)^{1/3}$. At high θ (>10) all methods give essentially the same results. At lower θ ($\approx$1.0), it appears that only the PY and BS methods give accurate results. At sufficiently low θ ($\approx$0.5), g shows oscillatory behavior. A power series was derived for g for ideal Bose-Einstein and Fermi-Dirac gases. Several computations of g were made using the series and the results are presented. A method was developed for computing g when the system is in the near classical region. This method approximates the Slater sum in such a form that the methods of classical statistical mechanics may be used to determine g. The method was specialized to the quantum electron gas. (Dissertation Abstr., 25: No. 1, 1964)

42860 POLARIZATION TRANSFORMATIONS WITH APPLICATIONS TO ANISOTROPIC PLASMAS. Richard Edmund Haskell. Thesis, Troy, N. Y., Rensselaer Polytechnic Inst., 1963. 152p.

The change in the polarization of an electromagnetic wave resulting from passage through an anisotropic plasma is studied. A systematic technique for handling elliptically polarized waves based on the properties of the Poincare sphere is developed. A method of analyzing polarization in terms of orthogonal elliptical polarizations is described. An analysis of electromagnetic wave propagation in anisotropic plasmas in terms of the principal axes is carried out. Expressions which tell how a wave of arbitrary polarization will change as it propagates along the magnetic field in an anisotropic plasma are obtained. A new method for determining the transformation matrix of a given plasma from two polarization measurements is described. From these measurements the polarization transforming properties of the plasma are completely specified. In particular, techniques are described, which predict the wave polarization that propagates unchanged through the plasma and the wave polarization that propagates with maximum intensity. Polarization experiments involving the free space propagation of microwaves through a laboratory plasma are described. The results show that the method leads to accurate predictions of the behavior of electromagnetic waves in magnetoplasmas. (Dissertation Abstr., 25: No. 1, 1964)

42861 UNSTEADY CONVECTIVE MAGNETOHYDRODYNAMIC CHANNEL FLOW. R. M. Singer (Argonne National Lab., Ill.). New York, American Inst. of Chemical Engineers, 1964, Preprint No. 8, 31p. $0.50. (CONF-644-6)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

The unsteady, combined convective flow of an energy generating fluid through a transverse magnetic field is analyzed for the fully developed case. Oscillatory behavior is induced by buoyancy and the MHD interaction and is damped by diffusive properties of the fluid. Hydrodynamic and heat transfer results are presented. (auth)

42862 IMPROVEMENTS IN OR RELATING TO PLASMA SOURCES. (to CSF-Compagnie Generale de Telegraphie Sans Fil). British Patent 969,831. Sept. 16, 1964. Priority date Jan. 16, 1962, France.

A plasma jet source is designed in which a very hot jet at 10,000 or 15,000°K can be produced without damage to the nozzle. In this source, the nozzle has an inner surface in the form of a truncated cone and a cylindrical plasma output channel at its smaller end. The diameter of the smaller end of the cone is larger than the diameter of the channel, so that a pocket of cool gas is formed at the corner between the cone and the channel, contracting the plasma and insulating the nozzle neck. (D.L.C.)

42863 IMPROVEMENTS RELATING TO ELECTRICAL DISCHARGE TUBES. Alan Alfred Ware (to Associated Electrical Industries Ltd.). British Patent 969,870. Sept. 16, 1964. Filed Mar. 1, 1962.

A toroidal electric discharge tube is designed with primary windings helically arranged around it for producing an electric field inside the tube. The windings are carried on supports mounted on the outer wall of the tube to allow adjustment of the individual turns of the windings both around the tube and radially. Thus, the disturbing magnetic fields which often penetrate the gaps in the tube, may be minimized by adjustment of the winding turns. (D.L.C.)

42864 TRANSMUTATION OF ELEMENTS. Noel Ignatius Rafferty. British Patent 970,091. Sept. 16, 1964. Filed June 19, 1962.

A process is given for the synthesis of helium and generation of energy. The process comprises admixing in the ratio 4 : 8 : 8 aluminum with a large volume/surface area ratio, sodium hydroxide, and water in air in a steel pressure vessel. A thermonuclear reaction is initiated which results in the formation of carbon and helium, and temperatures up to 235°C and pressures up to 1450 lb/in^2 are produced. (D.L.C.)

42865 INJECTION METHOD AND APPARATUS FOR CONTROLLED FUSION DEVICES. Charles C. Damm (to U. S. Atomic Energy Commission). U. S. Patent 3,152,959. Oct. 13, 1964.

Simultaneous injection through a single entrance port of a plurality of atomically neutral particle beams into an evacuated, charged-particle-confinement volume defined by a magnetic field to form a high-temperature confined plasma employable, e.g., in a controlled thermonuclear reactor is discussed. The injection is accomplished by magnetically aligning ion beams generated by a plurality of ion sources along a common path. The particles of the beams are subsequently neutralized and directed to pass through an entrance port of the chamber defining the evacuated region. By injecting a plurality of particle beams through a single entrance port, the extraneous leakage into the confinement volume is greatly reduced. (AEC)

Shielding

42866 (ML-TDR-64-52) FANTASIA II AND TRIPROD II—SHIELDING CODES FOR THE IBM 7090. Herbert A. Steinberg and Raphael Aronson (TRG, Inc., Melville, N. Y.). Feb. 1964. Contract AF33(657)-8277. 77p. (AD-601012)

FANTASIA II computes neutron transmission through laminated slab shields and slowing-down density within the shields by Monte Carlo methods. TRIPROD II is a slowing-down code suitable for shielding problems. These codes are based on FANTASIA and TRIPROD, shielding codes for the 1103A Univac. (auth)

42867 (MTP-RP-64-1) DISTRIBUTION OF UNBOUND CHARGED PARTICLES IN THE STATIC MAGNETIC FIELD OF A DIPOLE. Arthur D. Prescott (National Aeronautics and Space Administration. George C. Marshall Space Flight Center, Huntsville, Ala.). Jan. 14, 1964. 78p. (NASA-TMX-51312; N64-17685)

The distribution of relativistic unbound charged particles in the static magnetic field of a dipole with respect to a monoenergetic, isotropic, time-independent homogeneous distribution at infinity is determined by assuming Liouville's theorem and the Störmer theory of allowed and forbidden regions for unbound particle motion. The theory is applied to the dipole field of a finite current loop, and a study of the totally and partially shielded regions shows that the partially shielded region provides protection in the high-energy regime in which the totally shielded region is effectively non-existent. (auth)

42868 (TO-B-64-1) DOSE RATE DISTRIBUTION IN A COMPARTMENTED STRUCTURE. M. J. Barrett and R. L. MacNeil (Technical Operations, Inc., Burlington, Mass.). June 1964. Contract OCD-OS-62-14. 56p. (AD-604192)

Measurements are reported of the gamma radiation-induced dose in a compartmented steel structure. The experimental dose profile is compared with predictions based on computational techniques in the Office of Civil Defense Engineering Guide, as well as with computations performed by the Monte Carlo technique. Although agreement (within experimental accuracy) is reached between the Monte Carlo and the experimental measurements, the OCD predictions appear to overestimate the dose because of an incomplete consideration of the effect of spacing of the structure slabs. The degree of conservatism does not appear to be serious, however. (auth)

42869 (UJV-1032/64) MNOHOGRUPOVÝ VÝPOČET NEUTRONOVÉHO BIOLOGICKÉHO STÍNĚNÍ Z VRSTEV OCELI A GRAFITU. (Multiple Group Calculation of a Biological Neutron Shield With Layers of Steel and Graphite). B. Stočes (Československá Akademie Věd. Ustav Jaderného Výzkumu, Řež). [1963]. 18p.

A multigroup calculation is used to find the optimum relation of the quantity of iron and graphite in a multilayer neutron shield of fixed thickness and also the reflected influence of added absorber homogeneously dispersed in the graphite or concentrated behind the shield. It is shown graphically that the optimum thickness of steel is 20 to 30 cm, although it is pointed out this would probably not be used for structural reasons. It is shown that a shield consisting of a 20-cm layer of steel followed by 16 alternating layers of 10 cm of graphite than 5 cm of steel is improved very little by adding boron to the graphite or by adding a separate layer of boron. However, when the steel and graphite are in two layers of 60 and 80 cm, respectively, the addition of boron makes a distinct improvement. (TTT)

42870 (UNC-5093) UNC-SAM: A FORTRAN MONTE CARLO SYSTEM FOR THE EVALUATION OF NEUTRON OR GAMMA-RAY TRANSPORT IN THREE-DIMENSIONAL GEOMETRY. B. Eisenman and F. R. Nakache (United Nuclear Corp. Development Div., White Plains, N. Y.). Aug. 31, 1964. Contract DA-30-069-ORD-3625. 157p. (AD-605458)

A code system (called UNC-SAM), which evaluates the transport of neutrons or gamma rays using Monte Carlo methods in complex three-dimensional geometry, was written in FORTRAN for the CDC 1604-A computer. The code will calculate fluxes, flux dependent functionals such as doses, and their standard deviations in geometry comprised of rectangular parallelepipeds that in turn, may contain spheres, cylinders, parallelepipeds, or wedges. In order to increase the efficiency of the Monte Carlo transport game, UNC-SAM uses an importance sampling technique. In addition, in the particular case of evaluating neutron fluxes in small volume detectors, a scoring by analytical estimation referred to as "flux at a point" is employed. (auth)

42871 AN ANALYTICAL METHOD FOR THE CALCULATION OF RADIATION DOSE RATES DUE TO PROTONS. Rubin Goldstein (Univ. of California, Berkeley). Health Phys., 10: 684-7(Sept. 1964). (UCRL-10988; UCRL-10988 (Rev.))

An analytical expression is derived for the dose rate as a function of depth due to an arbitrary spectrum of high-energy protons incident on a space vehicle. The analytical result for 40-Mev protons incident on liquid hydrogen enclosed in a copper shell is in good agreement with the prediction of the graphical method. (D.C.W.)

42872 REPRESENTATION OF A FUNCTION BY ITS LINE INTEGRALS, WITH SOME RADIOLOGICAL APPLICATIONS. [PART] II. A. M. Cormack (Tufts Univ., Medford, Mass.). J. Appl. Phys., 35: 2908-13(Oct. 1964).

A method is described for determining a variable gamma absorption coefficient in a sample from measurements made outside the sample, and the applicability of the method to other radiological problems—positron scanning—is pointed out. An experimental test of the method is described, and it is concluded that the method works well. (auth)

42873 DEPTH-DISTRIBUTION CURVES OF ENERGY ABSORBED BY SUBSTANCES PRODUCING BREMSSTRAHLUNG. S. P. Kruglov and I. V. Lopatin (Ioffe Inst. of Physics and Tech., Leningrad). Med. Radiol., 9: No. 7, 52-5 (July 1964). (In Russian)

Depth distribution curves of absorbed energy are shown for various substances being exposed to bremsstrahlung with threshold energies of 22.5, 46, 70, and 85 Mev. The curve areas are correlated with the energy, corresponding with the accumulation of one Coulomb of the charge in the quantimeter of the standard ionization chamber. A simple method based on the employment of the curves is proposed to determine the energy evolved in one gram of material. The only value that should be determined in using the method is the ionizing charge accumulated in the standard chamber or in the quantimeter during irradiation. (auth)

42874 COMPARISONS OF MEASURED AND CALCULATED NEUTRON FLUXES IN LAMINATED IRON AND HEAVY WATER. E. Aalto (Aktiebolaget Atomenergi, Studsvik, Sweden). 16p. (CONF-446-14)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

In order to check the accuracy of some of the available shield design methods, a series of measurements was performed in various configurations of thin laminae of Fe and D_2O. The calculation methods used were able to predict the detailed, relative form of neutron flux distributions very accurately in thin laminae of Fe and D_2O. The absolute flux values predicted in a small geometry were very sensitive to the translation of the true geometry to one suitable for calculation. This was especially so in the case of ϕ_{th} which was, besides, quite sensitive to the thermal constants. The thermal values by NRN method in the geometry were generally within a factor of 2 from the measured ones. The agreement in the epithermal and fast fluxes was still better. In larger and more clean cut geometries the NRN method may be expected to give all three flux components within a factor of 2 from true values in most cases. The same applies to thermal flux by RASH B_3 method. (P.C.H.)

42875 INCORPORATION OF LEAD ORE IN SHIELDS FOR PROTECTION AGAINST NUCLEAR AND RADIOACTIVE RADIATIONS. A. Petitjean. French Patent 1,264,536. May 15, 1961. Filed May 10, 1960.

The utilization of granulated Pb ore for the manufacture of radiation shields without discontinuities is discussed. The ore, having a granulometric composition that is a function of the shield to be obtained, can be incorporated in synthetic resins, in paints, in impregnating emulsions, etc., or poured in containers. (NPO)

REACTOR TECHNOLOGY

General

42876 (ANL-6909) CATALOG OF NUCLEAR REACTOR CONCEPTS. PART I. HOMOGENEOUS AND QUASI-HOMOGENEOUS REACTORS. SECTION II. REACTORS FUELED WITH HOMOGENEOUS AQUEOUS SOLUTIONS AND SLURRIES. Charles E. Teeter, James A. Lecky, and John H. Martens (Argonne National Lab., Ill.). July 1964. Contract W-31-109-eng-38. 168p.

Research and testing reactors, non-boiling reactors for power and breeding, and boiling reactors for power and breeding are discussed. Data sheets for the individual concepts are given. Numerous references are included. (R.E.U.)

42877 (EUR-1850.e(p.31-52)) THE ORGEL PROJECT. J. C. Leny and S. Orlowski (European Atomic Energy Community).

Studies of a heavy-water-moderated reactor in which cooling is effected by a polyphenyl mixture are described. The Orgel program is aimed at development of improved coolants, development of fabrication methods for sintered aluminum products, studies of Zr alloy compatibility with organic coolants, and development of cheap UC fuel elements. (J.R.D.)

42878 (EUR-1850.e(p.53-9)) COMMUNITY FAST REACTOR PROGRAM. A. de Stordeur (European Atomic Energy Community).

A summary of the cooperative research programs among the EURATOM member states is presented. Work being pursued in EURATOM research establishments is discussed along with international cooperation problems. (J.R.D.)

42879 (EUR-1850.e(p.73-82)) EURATOM/UNITED STATES JOINT PROGRAMME. Pierre Kruys (European Atomic Energy Community).

Activities in a U. S.–EURATOM cooperative program are outlined. The objectives of this program are development of 1000-Mw(e) nuclear power plants of U. S.-proven design, to be constructed in the Community, and development of fuel cycles and waste disposal methods for these reactors. The program is concerned mostly with development of boiling-water and pressurized-water reactors. (J.R.D.)

42880 (EUR-1850.e(p.113-15)) THE PARTICIPATION OF EURATOM TO THE OECD INITIATIVES: THE DRAGON PROJECT. P. Caprioglio (European Atomic Energy Community).

A review of EURATOM participation in a five-year Dragon development program is presented. The project was initiated to develop high-temperature gas-cooled reactors and gain experience in their operation. (J.R.D.)

42881 (LA-3115-MS) NECKLACE—A COMPUTER PROGRAM CONCERNING THE TRANSIENT TEMPERATURES OF FISSIONING SPHERES IMBEDDED IN GRAPHITE. C. G. Chezem and W. R. Stratton (Los Alamos Scientific Lab., N. Mex.). Mar. 1964. Contract W-7405-eng-36. 71p.

The Necklace computer program describes the temperature-time-space relation within a spherical volume in which contiguous spherical shells of graphite are heated by conduction from a central heat source. This source term may be in the central sphere and in an arbitrary number of adjacent spherical shells. Numbers and sizes of regions, specific heats, conductivities, and the radial and time magnitudes of the heat source terms are arbitrary. Necklace (NEK) is coded in FORTRAN II (NEK-2) for IBM 7094 and in FORTRAN IV for IBM 7030. (auth)

42882 (NASA-TN-D-1587) NEUTRON SELF-SHIELDING FACTORS FOR MULTIPLE-BODY CONCENTRIC CYLINDRICAL CONFIGURATIONS. Thor T. Semler (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Sept. 1964. 18p.

Self-shielding factors for neutrons were computed by means of the Monte Carlo method for multiple-body cylindrical configurations of absorbers. It is found that large variations in the internal structure can lead to rather large variations in self-shielding factors. However, the average chord length generalization, which is proportional to the volume-to-surface ratio, is found to correlate self-shielding factors for concentric cylindrical configurations with high precision. (auth)

42883 (NYO-2679) HETEROGENEOUS REACTOR CALCULATION METHODS. Quarterly Progress Report No. 7, October 1, 1960–December 31, 1960. Carl N. Klahr, Lawrence B. Mendelsohn, and Jerome Heitner (TRG, Inc., Syosset, N. Y.). Contract AT(30-1)-2375. 119p. (TRG-129-QTR-7)

A complete description of the HERESY 2 code is presented. This code can be used in reactivity and power distribution calculations for complex lattice core arrangements in infinite reflectors taking into account multiple ^{238}U absorption resonances and ^{235}U fission resonances. The inclusion of the multiple resonances represents a distinct advance over HERESY 1 which included provisions for only one lumped absorption resonance. HERESY 2 includes many options within the code itself to increase its flexibility and to decrease input preparation and machine running time for very complex problems. Sections are included on input preparation, machine operating instructions, output formats, and a copy of the FORTRAN Source Program. Input and output for a sample HERESY 2 reactor problem are also given. (auth)

42884 (NYO-3194-1) TEST AND VERIFICATION OF HETEROGENEOUS REACTOR CALCULATION METHODS. Annual Report, April 1963–January 1964. Carl N. Klahr, Jerome Heitner, and Norman Stein (Fundamental Methods Associates, Inc., New York). Contract AT(30-1)-3194. 168p.

Experimental tests and further theoretical developments of heterogeneous reactor physics, as exemplified by the HERESY codes are reported. The experimental tests demonstrated that a high level of accuracy in reactor physics calculations is attainable by heterogeneous methods, surpassing the accuracy of homogeneous calculations. The theoretical work was concerned with detailed definition of calculation procedures; the required procedures were shown to be straightforward and simple. A better understanding of the assumptions of heterogeneous reactor physics was obtained. Its applicability was shown to be much more general than previously anticipated. (auth)

42885 FIVE-YEAR PROGRESS IN REACTOR PHYSICS IN JAPAN. Masuhiko Otsuka (Electric Power Development Co., Ltd., [Tokyo]). Nippon Genshiryoku Gakkaishi, 6: 460-7(Aug. 1964). (In Japanese)

Reactor physics research in Japan for the five years is summarized and a full list of the published papers is included. Most of them are theoretical, although experimental activities have been gradually increased. Some ideas are proposed in order to stimulate studies in this field. (auth)

42886 IMPROVEMENTS IN OR RELATING TO EXCHANGE PROCESSES. Arlette Marcelle Mihail and Clande Desire Foure (to Societe Nationale d'Etude et de Construction de Moteurs d'Activation). British Patent 969,963. Sept. 16, 1964. Priority date Dec. 9, 1959, France.

A reactor is described in which heat transfer from the fuel elements is accomplished by means of a moist gas, e.g., moist air or moist CO_2. Water is injected through orifices in the coolant channel to keep the gas humid. Several embodiments of the reactor are described. (D.L.C.)

Auxiliaries and Components

Refer also to abstract 43075.

42887 (CEA-R-2512) REALISATION ET ESSAI D'UNE BARRE DE CONTROLE TYPE "FOURCHETTE." (Construction and Testing of a "Fork" Type Control Rod). Roger Guicherd and Claude Meunier (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1964. 12p.

A control rod for reactors using plate-type elements is described. The use of such rods reduced flux peaks by 29%, increased control efficiency by 20%, and produced greater safety by reducing the number of parts. (D.E.B.)

42888 (SAL-2) THE GENERATION AND ACCELERATION OF POSITRONS (thesis). Donald Edward Lobb (Saskatchewan. Univ., Saskatoon. Saskatchewan Accelerator Lab.). Aug. 1963. 176p.

Positrons will be produced in the University of Saskatchewan Linear Electron Accelerator by allowing bursts of electrons accelerated by the first linac section to fall on a thick target. The resulting positrons can be accelerated by the three succeeding linac sections. The longitudinal equations of motion for positrons in a linear accelerator were solved and results are presented for the field configuration of the Saskatchewan linac sections. These results indicate that the minimum energy spread at output occurs if the positron burst is injected with an initial phase of 120° and the magnetic confining system is designed for positrons of 2 Mev total initial energy. For reasonable phase spread and energy spread at injection, these injection parameters will yield a positron beam of 39.4 ± 0.5 Mev at the end of the first positron accelerating section and of 114.5 ± 1.0 Mev at the end of the third positron accelerating section. Two tentative designs are presented for confining the positron beam within the accelerator aperture. The better system should give a net conversion efficiency of 4×10^{-4} e^+/e^- and a time average positron current of 0.07 μamp. The inferior, but less costly, system should give a net conversion efficiency of 0.7×10^{-4} e^+/e^- and a time average positron current of 0.01 μamp. (auth)

42889 DISPERSION-TYPE ABSORPTION MATERIALS FOR REGULATING RODS IN THERMAL REACTOR. V. I. Nosov, N. N. Ponomarev-Stepnoi, K. I. Portnoi, and E. G. Savel'ev. At. Energ. (USSR), 17: 107-13(Aug. 1964). (In Russian)

Results are presented from experimental and theoretical investigations of the physical characteristics of absorption materials of Nimonic-type alloys with dispersed oxides of rare-earths. The change of absorbing power as a function of composition is considered. The dependence of the mechanical and thermal-physical properties of the absorbing alloys on the concentration of implanted absorbers is presented, and results of a study of radiation effects on the materials are given. (tr-auth)

42890 ELECTRO-HYDRAULIC HANDLING MACHINE FOR NUCLEAR REACTORS. H. Flessner and G. Dose (Krupp-Ardelt GmbH, Wilhelmshaven, Ger.). Krupp Tech. Rev. (English Transl. Tech. Mitt. Krupp., Werksber.), 22: 91-5(July 1964).

In the course of experiments made in the central channel of a pilot reactor, loop assemblies with test specimens and adapters must be exchanged. During this operation, the charging room is exposed to radiation. It was for this reason that a handling machine was fitted with remote control for actuating the special tools exposed to radiation. This required a maximum degree of precision in the mechanical finish, control, and assembly of the machine. (auth)

42891 MODULAR REACTOR INSTRUMENTATION (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1095)

Drawings are presented for the wide-range counting instrument, which measures reactor power; the safety channel of the High Flux Isotope Reactor (HFIR), which controls scram latches; the regulation channel of the HFIR, which uses one control rod; and the PCP II multisection ionization chamber, which is neutron sensitive with one compensated and one uncompensated section used for control or safety functions. (D.C.W.)

42892 METHOD OF AND MEANS FOR EXCHANGING FUEL IN A NUCLEAR REACTOR. (to Allmanna Svenska Elektriska AG). British Patent 969,662. Sept. 16, 1964. Priority date Feb. 16, 1961, Sweden.

A charging machine is designed which may be used when the reactor is operating at full power. The machine comprises an outer radiation-protecting housing, a pressure vessel inside the housing, means for vertically displacing the vessel in the housing, a closeable charging opening for connection to a reactor, hoist means for the fuel assemblies, and means for positioning the fuel assemblies in storage positions. (D.L.C.)

42893 REACTOR HAVING APPARATUS FOR MANIPULATING IRRADIATED NUCLEAR FUEL. Ronal Scott Challender (to United Kingdom Atomic Energy). British Patent 969,685. Sept. 16, 1964. Filed June 1, 1962.

An arrangment is given for discharging irradiated fuel through the two containment vessels of a high-temperature gas-cooled reactor. In this arrangement, a fuel element storage magazine rotatably mounted on a horizontal axis is disposed between the inner and outer containment vessels, which are penetrated at different levels to provide an entry port and a discharge port, respectively. In operation, the magazine is rotated slowly so that decay of the irradiated fuel takes place before it comes into line with the discharge port. (D.L.C.)

42894 IMPROVEMENTS IN MODERATOR STACKS FOR NUCLEAR REACTORS. Jean Forestier (to Commissariat à l'Energie Atomique). British Patent 969,984. Sept. 16, 1964. Priority date Nov. 10, 1961, France.

A solid moderator bar is designed which enables the coolant circulation rate in the coolant channels to be modified. Besides the conventional bore in the bar which serves as the coolant channel, several grooves are provided in the bore, thus increasing the section of the coolant passage. The grooves may be helical if fuel elements with straight longitudinal fins are used, or straight if helical fins are used. (D.L.C.)

42895 ENERGY ABSORBING DEVICES. (to United Kingdom Atomic Energy Authority). French Patent 1,286,933. Jan. 29, 1962. Priority date Feb. 19, 1960, Great Britain.

The shock absorbing device is composed of a male and a female part the first of which receives the blow of a falling body. One part may consist of a striking pin with a conical bulgy head while the other may be a column of spaced rings within a cylindrical casing, the openings in the rings being smaller than the maximum diameter of the striking pin. The male part may also consist of a series of spaced parallel disks at the end of a supporting rod while the female part is a cylindrical casing with an internal constriction. Thus the falling body is arrested through the deceleration of the male part when it penetrates into the female part. These devices are applied as the bottom support of a vertical column of fuel elements, the male part carrying the column while the female part is fixed to the reactor channel. In normal operation conditions the male part is immobilized in the inactive top of the female part by means of a shearing pin. (NPO)

42896 NUCLEAR REACTORS AND FUEL ELEMENTS FOR SUCH REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,327,572. Apr. 8, 1963. Priority date July 4, 1961, Great Britain.

Nuclear reactors with vertical channels wherein the fuel elements are disposed one above the other so as to form columns are described. In order to save time during the recharging period, the fuel elements may be introduced as a unit with the possibility of discharging them one by one. During the charging operation, the elements are interconnected by means of a cable that can be removed afterwards from the reactor by a remote-controlled operation. The cable is in the form of a loop surrounding the lower extremity of the lowest fuel element and passing along the other fuel elements as soft guiding tubes provided for the elements. (IIB)

42897 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Societe Belge pour l'Industrie Nucleaire "Belgonucleaire" S.A.). French Patent 1,330,822. May 20, 1963. Priority date May 24, 1961, Belgium.

Control of the reactivity of a nuclear reactor by changing the composition of the moderator is described. The moderator is separated from the coolant and enclosed within fluid-tight cavities. Each cavity has an outlet duct leading the moderator to a separation unit, where it is separated into its components, e.g., into heavy and light water. The composition of the moderator is controlled by controlling the reflux of the components into the moderator cavities. (IIB)

42898 IMPROVEMENTS RELATING TO NUCLEAR REACTOR CONTROL. (to Societe Belge pour l'Industrie Nucleaire "Belgonucleaire" S.A.). French Patent 1,330,823. May, 1963. Priority date May 24, 1961, Belgium.

Reactivity control in nuclear reactors by a variation of the moderator composition is discussed. A design is presented in which the moderator space is divided into several subspaces filled with different moderators. The reactivity is controlled by changing the volume of at least one of the subspaces. Part of the subspaces are bounded by flexible tubes disposed within channels of the reactor and communicating via a pump and a reflex line with a storage chamber outside the reactor core. The pump serves to control the pressure inside the flexible tubes, and this pressure determines the volume of the tubes between a blown up and a compressed state. Some of the subspaces may have the shape of helically wound flexible tubes normally occupying the whole length of a reactor channel. By axial extension of such a tube-helix the volume of the pertinent subspace remaining in the reactor core is diminished. (IIB)

42899 IMPROVED NUCLEAR REACTORS. (to Societe Belge pour l'Industrie Nucleaire "Belgonucleaire" S.A.). French Patent 1,330,824. May 20, 1963. Priority date May 24, 1961, Belgium.

The reactivity of a proposed nuclear reactor is controlled by changing the characteristics of the moderator system. The reactor is subdivided into several cavities enclosing fluids of different moderating properties. One part of the cavities is adapted to be moved within the core from regions of a higher neutron flux to regions of a lower flux and vice versa. The reactor is cooled with heavy water, while casings filled with light water are adapted to be moved within a reactor channel. In order to improve the homogeneity of the moderating system a series of small casings is provided, interconnected by helicoidal springs with the lowest fixed at the bottom of the reactor channel. The distances between adjacent casings are simultaneously controlled by controlling the position of the uppermost casing. (IIB)

42900 CONTROL ROD DRIVE FOR NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,332,091. June 4, 1963. Filed May 30, 1962.

A control rod drive especially adapted for use in swimming pool reactors was designed with a tubular casing enclosing an electric motor driving an axially fixed bolt engaging via a nut with a rotatively fixed element adapted to slide within the casing and joined to the control rod. The motor, which may be of the squirrel cage type, drives at different speeds via reduction gears two telemetering emitters allowing the determination of the control rod position. The control rod is coupled to the supporting element by an electromagnet excited via a wire passing through, and comprising a coiled up section above, this element. (IIB)

42901 IMPROVEMENTS RELATING TO SYSTEMS FOR PROVIDING AN ELECTRIC CONNECTION ALONG A REACTOR CHANNEL. (to Commissariat a l'Energie Atomique). French Patent 1,333,933. June 24, 1963. Filed June 23, 1962.

A transmission system for electric signals, e.g., the signals of thermocouples disposed at different levels of a reactor channel within a series of sleeves comprising fuel elements, was designed with contact means disposed at the axial extremities of the sleeves so that corresponding means of adjacent sleeves are elastically applied one against another by common placing of these sleeves one above another, and conducting wires connecting the corresponding contact means disposed at the two extremities of the same sleeve, or connecting the thermocouples with means at one extremity of the sleeve. The contact means at one extremity of the sleeve are formed by collector rings, while at the other extremity contact reeds are provided. (IIB)

42902 MODERATOR LEVEL DETECTOR FOR A NUCLEAR REACTOR. (to Groupement Atomique Alsacienne Atlantique). French Patent 1,336,826. July 29, 1963. Filed July 25, 1962.

The detector is made of movable equipment consisting of a float-like piece adapted to plunge into the moderator and a rod connecting this float with a support disposed outside the biological shield and fixed to the movable end of a spring. The rod is extended by a piece forming the core of a differential transformer, the primary coil of which is supplied by a suitable a-c source, while the secondary coil is connected to an indicator. The spring compression due to the float weight and diminished by the action of the buoyancy of the float is measured with the aid of the differential transformer. (IIB)

42903 ELECTRO-MAGNETIC DEVICE FOR THE DISPLACEMENT OF A ROD SHAPED PIECE INSIDE A TUBE, ESPECIALLY OF A CONTROL OR SHUT DOWN ROD OF A NUCLEAR REACTOR. (to Siemens-Schuckertwerke A.G.). French Patent 1,337,222. Aug. 5, 1963. Priority date Aug. 4, 1960, Germany.

The device consists of a series of coils enclosing the tube. Adjacent coils have common armature pieces, the magnetic field of which acts through the tube wall on the rod to be moved. This rod is enclosed by a ferrite cover provided with a series of spaced annular ribs. Over a given length the number of ribs is different from the number of coils so that by a successive excitation of the coils the rod may continually be moved. The tube is composed of an assembly of alternately disposed rings of magnetizable and non-magnetizable material, the former constituting the pole shoes of the coil's armatures. (IIB)

42904 TEMPERATURE MEASURING APPARATUS. (to United Kingdom Atomic Energy Authority). French Patent 1,337,835. Aug. 12, 1963. Priority date Aug. 3, 1961, Great Britain.

An apparatus was designed for measuring the surface temperature of a fuel element within a nuclear reactor and consists of a thermocouple, the d-c signal of which indicates the difference in temperature between a point on the fuel element surface and a reference point within the fuel element. The temperature in the reference point is measured with the aid of a cavity closed by a diaphragm and filled with a fluid. The temperature of the fluid determines the resonant frequency of the diaphragm. The vibration of the diaphragm is excited by an electric coil, which is supplied by a wobbulated oscillator, so that the resonant frequency of the diaphragm, corresponding to the frequency at which the coil impedance has its maximum, may be measured. (IIB)

42905 COUPLING MECHANISM. (to General Dynamics Corp.). French Patent 1,340,380. Sept. 9, 1963. Priority date Nov. 8, 1961, United States.

A mechanism was designed for coupling the control rod with its drive means, which consists of a winch for hoisting a cable, the free end of which may be lowered into a reactor channel, and supports the first part of the coupling mechanism adapted to engage with the second part fixed to the upper end of the control rod. This second part consists of a tubular piece, the open upper extremity of which is extended by a funnel like portion. Two pairs of lugs are provided at two opposite sides on the tubular piece, onto which are pivotally mounted two radially extending locking rods reaching with their inner ends via appropriate openings into the tubular piece. The second part of the coupling mechanism consists of a cylindrical piece provided with a shoulder with which the locking rods may cooperate. For releasing the control rod it is led down to its lowest position, while the coupling device lowers a little more. Then, a hollow decoupling plunger released from the reactor top slides down over the cable and finally pushes the locking rods downwards so that the two parts of the coupling device may easily be separated. (IIB)

42906 CONTROL ROD DRIVE FOR NUCLEAR REACTORS. (to General Dynamics Corp.). French Patent 1,340,872. Sept. 16, 1963. Priority date Aug. 23, 1961, United States.

A control rod drive composed of a screw engaging with a nut fixed to the control rod, while the screw is connected to a driving shaft via a free wheel, was designed. During normal reactor operation this shaft is driven by an electric motor via electromagnetic coupling. In case of emergency a fluid motor connected with the driving shaft is supplied with a pressurized fluid, e.g., helium, for quickly introducing the control rod into the reactor core. An additional control valve is provided for regulating the fluid supply according to the position of the control rod in order to retard the control movement toward the end of its path. (IIB)

42907 ENERGY ABSORBING DEVICE. (to United Kingdom Atomic Energy Authority). French Patent 1,342,654. Sept. 30, 1963. Priority date Jan. 8, 1962, Great Britain.

In nuclear reactors it is necessary to provide a device for absorbing the kinetic energy of a falling control rod at the end of its path. The device described creates a uniform slow-down force and accumulates only a small amount of recoverable elastic energy. It consists of an element formed by a thin steel sheet. The sheet has the shape of an elongated cylinder, which at its upper end is provided with a short, turned-down external portion coaxially with the cylindrical portion, and connected with the latter by a curved transitional portion. A cylindrical sleeve lining the inner surface of the main portion is fixed to the latter at the lower end while a second cylindrical sleeve covers the external portion and is fixed to the lower end of it. This second sleeve transmits the impact to the element and provokes a controlled deformation resulting in a lengthening of the external portion and a shortening of the main portion. (IIB)

42908 IMPROVEMENTS RELATING TO NUCLEAR REACTOR CONTROL. (to Babcock and Wilcox Ltd.). French Patent 1,343,245. Oct. 7, 1963. Priority date Dec. 22, 1961, Great Britain.

A nuclear reactor was designed with control by introduction or withdrawal of neutron absorbing, suitably ball-shaped elements via a series of channels reaching from outside the reactor to different levels within the core. These elements are displaced by a controlled fluid flow within the channels. The portion of the channels outside the core is at a higher level than the core top, so that in case of a reduction or loss of upward fluid flow within the channel the elements fall into a position within the reactor core. The channels are tubes with a progressively increasing cross section or are composed of several tubular pieces with different cross sections. Each channel wall may be provided with lateral openings at different levels through which additional fluid enters the tube. This results in a step-like fluid speed distribution along the channel, so that the balls may be moved by series, each series corresponding to the distance of successive openings along the channel axis. (IIB)

42909 IMPROVEMENTS RELATING TO DEVICES FOR LOCKING PLUGS IN NUCLEAR REACTOR CHANNELS. (to Commissariat a l'Energie Atomique). French Patent 1,343,577. Oct. 14, 1963. Filed Sept. 3, 1962.

A plug was designed with a series of levers pivotally mounted in the plug's body and adapted to swing out laterally in order to engage in an annular groove provided in the reactor wall. The movements of the levers are simultaneously controlled by axial displacement of a central piece linked to the levers and sliding on a central rod extending from the plug's body. Normally the levers are pushed into the annular groove by a spring acting on the central piece. For unlocking the plug a telescopic handling tool is approached to the plug and centered on a central rod of the plug. By pushing the central piece back by the tool, the locking levers are forced to swing inwardly and to engage with appropriate hooks on a shoulder of the manipulating tool, so that the plug may be withdrawn. (IIB)

42910 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,346,163. Nov. 4, 1963. Priority date Feb. 1, 1962, Great Britain.

To compensate for reactivity losses due to fuel burnup in a spectral shift reactor, a quantity of a certain liquid is periodically introduced into the circuit of the reactor coolant in order to change the moderating characteristics of it. During this injection the same quantity of reactor coolant has to be withdrawn. Two chambers are provided and adapted to be alternately branched within a continuously working purification circuit forming a by-pass of the cooling circuit, so that the purified coolant may flow through one of these chambers before it is reinjected. In preparing for injection of the liquid quantity, the chamber is separated from the purification circuit, drained and refilled with the liquid to be injected, after which the chamber is branched within the purification circuit. (IIB)

42911 CONTROL ROD FOR NUCLEAR REACTOR. (to Groupement Atomique Alsacienne Atlantique). French Patent 1,347,126. Nov. 18, 1963. Filed Nov. 12, 1962.

A reactor control rod consisting of a series of tubular pieces fitting one into another in order to form a telescopic system is described. Each element consists of two tubular pieces of different diameter with the smaller piece adapted to slide within the thicker one of the adjacent element between two stops formed by shoulders on the pieces, so that any break-up between adjacent elements is prevented. The lower element may be fixed within a reactor channel, while the system is moved by moving the uppermost element and vice versa. This control rod may be used as a safety rod adapted to fall into the reactor core, in which case the system comes to rest after a series of energy absorbent impacts corresponding to the different elements. (IIB)

Criticality Studies

Refer also to abstract 42606.

42912 (ACNP-64585) SHAPED BURNABLE POISON DEVELOPMENT PROGRAM UNDER THE EURATOM PROGRAM. FINAL REPORT [ON] FABRICATION DEVELOPMENT, DECEMBER 1, 1962–JUNE 30, 1964. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Bethesda, Md.). Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1229. 102p. (EURAEC-1168)

The reactions between Gd_2O_3 and Al_2O_3, Gd_2O_3 and UO_2, and $Gd_2O_3-M_xO_y$ (diluent oxide) and UO_2 were investigated at 2650 to 3500°F. Results indicated that Gd_2O_3 cylinders dispersed in an Al_2O_3 rod began to react at 2650°F and were completely destroyed at 3000°F. Gd_2O_3 cylinders dispersed in a UO_2 rod began to react at 2850°F and were completely destroyed at 3100°F. Reactions or other undesirable effects with UO_2 were observed below 3180°F for $Gd_2O_3-M_xO_y$ cylinders, where the diluent oxide was, successively: TiO_2, Fe_2O_3, Co_2O_3, and B_2O_3. Only slight reactions with UO_2 at 3180°F were observed with cylinders of $Gd_2O_3-ZrO_2$ and $Gd_2O_3-Cr_2O_3$. All $Gd_2O_3-M_xO_y$ cylinders were destroyed in reactions with UO_2 at 3500°F. Methods of inhibiting the $Gd_2O_3-UO_2$ reaction were studied. These studies included a selective location of Gd_2O_3 shapes in the low temperature region around a fuel rod periphery and a coated diffusion barrier concept. A UO_2 annulus containing dispersed $Gd_2O_3-ZrO_2$ cylinders was fabricated. Methods and processes were developed for fabricating thin Gd_2O_3 wafers of uniformly high quality. Processes were developed that would produce high quality dense Gd_2O_3 or $Gd_2O_3-M_xO_y$ cylinders and disperse them in an Al_2O_3 or UO_2 rod. Processes were also developed for fabricating a multihole Al_2O_3 matrix to contain Gd_2O_3 or $Gd_2O_3-ZrO_2$ cylinders in a specified uniform array. Sixty-four capsules containing both homogeneous and shaped poisons were fabricated for physics tests. (auth)

42913 (ACNP-64586) SHAPED BURNABLE POISON DEVELOPMENT PROGRAM UNDER THE EURATOM PROGRAM. FINAL PHYSICS REPORT, DECEMBER 1, 1962–JUNE 30, 1964. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Bethesda, Md.). July 20, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1229. 116p. (EURAEC-1169)

Nuclear cross-section data were reviewed and compiled for gadolinium, Gd-155, and Gd-157. Burnable poison requirements were computed for a large, low-enriched UO_2 boiling-water reactor with fuel lifetimes from 10,000 to 25,000 Mwd/ton. Four U-235 enrichments, from 1.8 to 3.8 wt %, and three H_2O- to UO_2-ratios, from 2.0 to 3.0, were studied. The burnable poison requirements, computed for power operation with all control rods fully out, suggest the use of Gd lumps shaped as cylinders. Core shutdown requirements were also computed. A comparison was made between B-10 and Gd as burnable poisons. An analytical model was developed to compute the self-shielding of high absorbing cylinders, and methods were developed to compute the neutron interaction among these cylinders. A computer program was written to perform depletion calculations for high absorbing cylinders. Danger coefficient measurements were performed for 64 poison capsules. These capsules contained homogeneous Gd_2O_3 or B_2O_3 or Gd_2O_3 lumped as cylinders or wafers. Analytical methods were developed to compute the absorption cross section and to compare computed results with measured results. Four of these 64 capsules contained homogeneous Gd_2O_3 and were irradiated up to 1×10^{20} nvt; nine of the capsules contained Gd_2O_3 cylinders and were irradiated up to 7×10^{20} nvt. Danger coefficient measurements were made on the irradiated capsules. Measured and calculated absorption cross sections were compared as a function of nvt. (auth)

42914 (CEA-R-2452) PROSERPINE—PLUTONIUM-239. PROSERPINE—URANIUM-235. COMPARAISON DE RESULTATS EXPERIMENTAUX. (PROSERPINE—Plutonium-239. PROSERPINE—Uranium-235. Comparison of Experimental Results). Jean-Paul Brunet, Robert Caizergues, Christain Clouet D'Orval, Jacques Kremser, Jean Moret-Bailly, and Philippe Verriere

(France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1962. 86p.

The PROSERPINE homogeneous reactor consists of a tank, 25 cm dia and 30 cm high, surrounded by a composite reflector made of beryllium oxide and graphite. In this tank plutonium or 90% enriched uranium solutions, the fissile substances being in the form of a dissolved salt, can be made critical. In varying the concentration of the solution, critical masses were studied as a function of the level of the liquid in the tank. The minimum critical mass is 256 ± 2 gm for plutonium and 409 ± 3 gm for uranium-235. In the range of the critical concentrations studied, the neutronic properties of fissionable solutions of plutonium and enriched uranium were compared for identical geometries. (auth)

42915 (CEA-R-2453) EXPERIENCE DE CRITICITE SUR UNE SOLUTION DE POLUTONIUM ET D'URANIUM ENRICHI A 90%. RESULTATS EXPERIMENTAUX ET CALCULS CONCERNANT LA CUVE N° 2 ($\phi = 300$). (Criticality Experiment on a Solution of Plutonium and of 90% Enriched Uranium. Experimental Results and Calculations on Tank Number 2 ($\phi = 300$ mm)). Jean G. Bruna, Jean-Paul Brunet, Christian Clouet D'Orval, and Jacques Kremser (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). June 1964. 26p.

Experiments on plutonium and 90% enriched uranium solutions were made in the ALECTO reactor with a tank of external diameter 300 mm. Various geometries were tested for variable concentrations of fissionable salts. The critical mass was studied as a function of the concentration in various reflector conditions (water, concrete, wood) and the experimental values were compared with calculated values. The effects of cadmium as a reflector and of the stainless steel tank were also studied. Measurements of β/τ, ratio of the effective fraction of delayed neutrons to the average lifetime of the neutrons in the reactor, were carried out. (auth)

42916 (CEA-R-2490) MESURES POUR ENSEMBLE SOUS-CRITIQUE URANIUM-EAU LEGERE D'ENSEIGNEMENT. (Measurements for a Subcritical Uranium–Light Water Assembly for Instruction). Jean-Yves Barre (France. Commissariat à l'Energie Atomique. Centre d'Études Nucléaires, Grenoble). Aug. 1964. 26p.

The material buckling, which may occur in a natural uranium–light water subcritical assembly intended for educational purposes, cannot be determined from measurements made on the initial lattice as is shown by the calculation of the thermal neutron flux distribution perturbed at all points by energy transitions and source and reflector space transitions. Various modifications were carried out with a view to decreasing the effects of these perturbations: increase in the core diameter, a cadmium screen at the core-reflector interface, a graphite supporting block, and the use of six sources placed octagonally. These improvements made it possible to determine the material buckling: $B^2_m = -1.8 \pm 0.2\ 10^{-4}\ \mathrm{cm}^{-2}$. (auth)

42917 (CEA-R-2513) ESSAI D'UN REACTIMETRE POUR REACTEUR A EAU LEGERE DANS LA GAMME +500, −5000 pcm. (Testing of a Reactimeter for a Light Water Reactor in the Range +500 to −5000 pcm). Gerard Chauvet (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). Aug. 1964. 27p.

The apparatus is designed to measure instantaneously the positive or negative reactivity of a uranium reactor moderated by light water, on condition that the point of departure is the critical state of the reactor, or an already known subcritical state. Slight modifications are required to adapt it to another type of reactor. It is an analog computer that simply inverses the transfer function of the reactor; it is not therefore a model reactor of which the output voltage is connected by a servomechanism to the power of the reactor to give the reactivity; the principle of the calculation of the reactivity does not depend on a servomechanism. One of its disadvantages is that it cannot operate outside a power variation range of 2 to 5 decades. However the measurement of a negative reactivity value between 0 and 3,000 pcm is immediate. It measures the reactivity without deducting it from the period; it therefore gives the reactivity very precisely both for divergence and convergence even though in this latter case the period does not in fact exist. The equipment makes it possible to calibrate very rapidly the control rods of a reactor (the rod-drop method), to measure the reactivity of an experiment in the core, and to measure certain temperature effects. It is also possible by introducing a control into the core at a measured rate, to deduce directly its efficiency curve. (auth)

42918 (CEA-R-2548) ETUDE DES FLUX DE NEUTRONS RAPIDES ET INTERMEDIAIRES DANS UNE PILE A GRAPHITE. (Study of Fast and Intermediate Neutron Fluxes in a Graphite Pile). Jacques Brisbois and Michel Lott (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses). 1964. 58p.

With a view to determine the flux and the spectral distribution of fast neutrons in the core of graphite piles, experiments were carried out in the critical assembly MARIUS. After giving the moderating properties of graphite and the calculation of the spectral distribution in an infinite and homogeneous graphite medium, the spectrum in a cell is calculated using simple hypotheses; it is assumed that the neutron flux at a point is the sum of a shock-less flux and of a flux after shock, which is independent of calculation. Calculated and experimental results are compared for several geometric configurations. (auth)

42919 (CEA-R-2549) SIMULATION DES EXCURSIONS DE PUISSANCE — PILE OSIRIS. (Simulation of Power Excursions — [Osiris Reactor]). Adrien Pascouet (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). Aug. 1964. 77p.

Following the experimental work accomplished in the U.S.A. on BORAX 1 and SPERT 1, and the accident of SL 1, the "Commissariat à l'Energie Atomique" started a research program about the safety of its own swimming pool reactors, with regard to power excursions. The first research work led to the design of programmed explosive charges, adapted to the simulation of a power excursion. The report describes the application of these methods to the investigation of OSIRIS safety. (auth)

42920 (K-DP-36) AN IBM 7090 PROGRAM FOR CALCULATING SPACING AND MULTIPLICATION FACTOR FOR ARRAYS OF CYLINDERS. J. R. Knight (Oak Ridge Gaseous Diffusion Plant, Tenn.). Jan. 9, 1963. Contract W-7405-eng-26. 20p.

An IBM 7090 program for determining critical spacing and total fractional solid angles in arrays of cylindrical containers of fissionable material is described. It is designed to replace previous hand computation methods with a more rapid and accurate FORTRAN code. The various options available in the computing procedure are also described. (auth)

42921 (K-DP-46) AN IBM 7090 PROGRAM FOR CALCULATING THE FRACTIONAL SOLID ANGLES AND MULTIPLICATION FACTOR OF A 3-DIMENSIONAL ARRAY OF IDENTICAL SPHERES. J. R. Knight (Oak Ridge Gaseous Diffusion Plant, Tenn.). Jan. 28, 1963. Contract W-7405-eng-26. 6p.

A description is given of a program for determining the critical spacing and total fractional solid angles in arrays of spherical containers of fissionable material. The options available in the program are described, and flow charts and FORTRAN listings of the program are given. (auth)

42922 (KR-71) K-7 TRANSPO—ONE-GROUP NEUTRON TRANSPORT IN A HETEROGENEOUS CYLINDRICALLY SYMMETRIC REACTOR CELL. R. J. J. Stamm'ler (Norway. Institutt for Atomenergi, Kjeller). 1964. 39p. (NORA-9)

The basic physical theory and the programming of the computer code K-7 TRANSPO are given. The code evaluates the neutron flux distribution in an infinitely long heterogeneous reactor cell with cylindrical symmetry, using integral transport theory in the one-group approximation. Scattering is assumed isotropic in the laboratory system and the boundary condition at the outer boundary of the cell can be either perfect reflection or isotropic flux return. The evaluation of the transport kernel, which is the most time-devouring part of the code, has received special attention to enable its calculation even on computers with a small fast memory. Detailed flow diagrams are included. They will facilitate the programming of K-7 TRANSPO on any digital computer. (auth)

42923 (MITNE-46) HEAVY WATER LATTICE PROJECT ANNUAL REPORT. Irving Kaplan, D. D. Lanning, and T. J. Thompson, eds. (Massachusetts Inst. of Tech., Cambridge). Sept. 30, 1963. Contract AT(30-1)-2344. 136p. (NYO-10212)

An experimental and theoretical program on the physics of heavy water-moderated, partially enriched lattices is reported. Experimental methods were adapted or developed for research on buckling, fast fission, resonance capture, and thermal capture. After being successfully tested on lattices of one-inch-diameter natural-uranium rods in heavy water, the methods were applied to three lattices of ¼-inch, 1.03% enriched uranium rods, moderated by heavy water. Research programs are also under way to take and correlate data from single-rod measurements, two-region lattice measurements, miniature lattice measurements, and pulsed neutron methods. In addition, a program is under way to measure the effect of control rods in the lattice assembly. A listing of topical reports, generated during the report period, is included. (auth)

42924 (TID-7050(p.537-52)) PARTICLE SELF-SHIELDING IN PLATES LOADED WITH SPHERICAL POISON PARTICLES. W. B. Doub (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

The self-shielding properties of an unordered system of small poison spheres bound together in a neutral plate-type matrix were studied. An approximate method was used to compute the case of arbitrary poison volume fraction. (R.E.U.)

42925 (TID-7050(p.595-620)) REPRESENTATION OF PLATE SELF-SHIELDING IN DIFFUSION THEORY. W. H. Hannum (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

An adequate diffusion theory representation for heterogeneous systems containing strongly absorbing plates is given that yields results comparable to those of higher order transport theory. Explicit blackness representation is used, and an epithermal representation for resonance absorption in a hafnium control rod is obtained. (R.E.U.)

42926 (TID-7050(p.620-56)) HOMOGENIZATION TECHNIQUES. R. S. Wick (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Homogenization of heterogeneous reactor materials for diffusion theory calculations is discussed. Homogenized constants were obtained from cell theory for thermal energies. Methods for epithermal representation including self-shielding are discussed. The validity of the cell assumption as applied to arrays of absorbing plates and full core calculations involving homogenization of much larger regions, including control rods and self-shielded burnable poisons, is discussed. (R.E.U.)

42927 (TID-7050(p.657-678)) SINGLE-CHANNEL SYNTHESIS. J. H. Leonard (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

The development of three-dimensional flux and power distributions in a reactor by combining one- and two-dimensional calculations for different portions of the reactor core is discussed. Synthesis (combination) involving a single axial function is known as single-channel synthesis, and is discussed. (R.E.U.)

42928 (TID-7050(p.678-710)) MULTICHANNEL SYNTHESIS. E. L. Wachspress (Knolls Atomic Power Lab., Schenectady, N. Y.).

The development of three-dimensional flux and power distributions in a reactor by combining one- and two-dimensional calculations for different portions of the reactor core is discussed. Synthesis involving simultaneous computation of several flux distributions parallel to the z axis is discussed. (R.E.U.)

42929 (TID-7050(p.710-28)) VARIATIONAL SYNTHESIS. S. Kaplan (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

The development of three-dimensional flux and power distributions in a reactor by combining one- and two-dimensional calculations for different portions of the reactor core is discussed. It is assumed that the radial flux distributions are not independent of the axial flux distributions and that they vary continuously with the axial position. A set of trial radial distributions, representative of the possible extreme radial distributions, are combined by means of a variational principle applied to the flux distributions over the entire core to give the optimum combination of these trial radial flux distributions as a function of axial position, thus yielding a continuous distribution of flux in three dimensions. (R.E.U.)

42930 (TID-7050(p.728-51)) GROSS FISSION-PRODUCT POISONING. E. C. Hansen (Knolls Atomic Power Lab., Schenectady, N. Y.).

Calculation of the gross fission product poisoning in a reactor core for an arbitrary neutron flux spectrum and flux spectrum history as a function of fuel depletion is discussed. Fission product yields are given for highly enriched systems, but the techniques may be applied to natural or slightly enriched systems where formation of fission products by fast fission of ^{238}U and fission in ^{239}Pu and ^{241}Pu must be considered. (R.E.U.)

42931 (TID-7050(p.800-46)) BURNABLE POISONS. A. Radkowsky (Division of Reactor Development, AEC).

The theory of the application of homogeneous burnable poisons is presented, areas in which the theory is inadequate are discussed, and modifications in reactor design arising for the use of burnable poisons are indicated. Use of burnable poisons in thermal reactors, materials suitable as burnable poisons, self-shielded burnable poisons, nonuniform depletion effects and zoning, and use of burnable poisons in natural-uranium fueled reactors and in epithermal reactors are discussed. (R.E.U.)

42932 (TID-7050(p.855-77)) NEUTRON KINETICS. A. F. Henry (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Kinetic equations used to describe the space-time behavior of the neutron flux in a reactor are considered. A physical interpretation of the adjoint flux as iterated fission probability is treated mathematically. (R.E.U.)

42933 (TID-7050(p.877-955)) REACTOR SYSTEM KINETICS. J. N. Grace (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Methods of analysis of reactivity feedback phenomena are developed, and effects on system stability are evaluated. Space and time are assumed separable for the reactor kinetics ordinary differential equations used. The dynamic boundary value problems of flux tilt transients and spatial stability are treated. The frequency-response method of stability analysis is used for xenon poisoning and system pressure variations. The effects of boiling on reactivity feedback and stability are discussed. (R.E.U.)

42934 (TID-7050(p.955-1010)) SPACE-TIME KINETICS. S. Kaplan (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Methods for analyses of reactor kinetics problems where space and time are not separable are outlined. Included are instantaneous tilt, nodal analysis, and modal analysis. No xenon feedback is assumed except for the modal analysis. (R.E.U.)

42935 (TID-7050(p.1010-1130)) KINETICS OF LOW-SOURCE LEVEL. D. R. Harris (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Reactor startup is analyzed as a stochastic process. Effects of feedback on the statistical behavior of a multiplying system are examined. The origins of reactor source neutrons are discussed because of the importance of a knowledge of (weak) source strengths in the computation of reactor fluctuations. (R.E.U.)

42936 (TID-7050(p.1148-1218)) HIGHLY ENRICHED CLEAN CRITICAL EXPERIMENTS AT AMBIENT TEMPERATURES. D. R. Connors (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Experiment and theory are compared for critical assemblies of a simplified geometry, which is clean of an axial inhomogeneity due, for example, to the partial withdrawal of the safety rods. Results are given for clean critical slab experiments for small-bundle box geometry and repeating plane geometry for metal-water systems, and for plastic-moderated critical experiments. (R.E.U.)

42937 (TID-7050(p.1218-45)) HIGHLY ENRICHED CLEAN CRITICAL EXPERIMENTS AT ELEVATED TEMPERATURES. L. O. Herwig (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh); and W. Skolnik (Knolls Atomic Power Lab., Schenectady, N. Y.).

Experiment and theory are compared for some high-temperature clean cores; reactivity and power distributions were studied. Experimental results from both the Pressurized Test Reactor and High Temperature Test Facility are discussed. (R.E.U.)

42938 (TID-7050(p.1245-75)) INVESTIGATIONS OF NEUTRON PEAKING IN HIGHLY ENRICHED CLEAN CRITICAL EXPERIMENTS. F. Feiner, S. Weinstein, and W. B. Wright (Knolls Atomic Power Lab., Schenectady, N. Y.).

A critical experiment for studying the transient behavior of the neutron flux near discontinuities in a central test lattice region of a reactor is described. The experiment was performed in a plastic-moderated dry critical assembly. (R.E.U.)

42939 (TID-7050(p.1275-1319)) HIGH U^{238} CONTENT CRITICAL EXPERIMENTS AT AMBIENT TEMPERATURE. D. Klein (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Resonance absorption and measurements of effective ^{238}U capture integrals were studied for rods of U and UO$_2$. Thermal utilization was also investigated using fission detectors. (R.E.U.)

42940 (TID-7050(p.1319-57)) PULSED NEUTRON SOURCE MEASUREMENTS. D. R. Bach, S. I. Bunch, R. J. Cerbone, K. S. Quisenberry, B. E. Simmons, and R. E. Slovacek (Knolls Atomic Power Lab., Schenectady, N. Y.).

Pulsed-neutron techniques for critical and subcritical measurements of reactivity are discussed. Calibration in a critical configuration is described. (R.E.U.)

42941 (TID-7050(p.1357-96)) LOW-ENERGY MEASUREMENTS OF THE NEUTRON SPECTRUM. S. I. Bunch, J. R. Roesser, and R. E. Slovacek (Knolls Atomic Power Lab., Schenectady, N. Y.).

Results are given from measurements of neutron spectra in water- and polyethylene-moderated assemblies. A method is described for simulating the flux at a given point within the core by means of a small, fuel-loaded assembly in the thermal column of a test reactor; the assembly serves as a source of neutrons that can be spectrum analyzed in a time-of-flight spectrometer. (R.E.U.)

42942 (TID-7050(p.1461-1511)) DIGITAL COMPUTER PROGRAMS FOR REACTOR PHYSICS CALCULATIONS. B. H. Mount (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh); and G. J. Habetler (Knolls Atomic Lab., Schenectady, N. Y.).

Brief descriptions are given of major computer programs developed by the Naval Reactors Laboratories for physics calculations on the IBM 704 or Philco 2000. Included are codes for use in few-group one-, two-, and three-dimensional diffusion theory, few-group one-, two-, and three-dimensional depletion calculations, few-group constants calculations, approximations to transport theory, Monte Carlo calculations, theoretical cross-section calculations, perturbation calculations, and modal calculations. (R.E.U.)

42943 (UJV-971/63) ŘETĚZOVÁ REAKCE S RYCHLÝMI NEUTRONY VE VRSTEVNATÉ MŘÍŽI. (Chain Reaction With Fast Neutrons in a Laminated Lattice). J. Cermák, I. Marek, and M. Grmela (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1963]. 11p.

Solution of the kinetic equation was used to investigate the probability of fast-neutron chain reaction in an infinite heterogeneous slab system composed alternately of plates of ^{235}U and ^{238}U. The material parameter B is expressed numerically for enrichments of 10, 20, 30%, for various sizes of the lattice. From the results it is evident that B is diminished by increased heterogeneity. For the homogeneous case, the following values were obtained for the parameter B: for 30% enrichment, B = 0.185; for 20%, B = 0.144, and for 10%, B = 0.682. Tables of various parameters necessary for the calculation as a function of energy from 0.01 to 4.60 Mev are given. The calculations were carried out on the Ferranti SIRIUS. (TTT)

42944 (ANL-Trans-62) SOME POINTS ON THE ELIMINATION OF DRIFT IN THE ANALYSIS OF PERIODIC FUNCTIONS. P.-A. Bliselius (Aktiebolaget Atomenergi, Stockholm). Translated for Argonne National Lab., Ill., from report TPM-RFX-250. Sept. 3, 1963. 9p.

The elimination of drift in Fourier analyses is discussed. The reduction of errors in pile oscillator measurements by correction of the aperoidic terms in the response signal is considered. (R.E.U.)

42945 THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE EFFICIENCY OF ABSORPTION RODS IN A REACTOR WITH A REFLECTOR. N. N. Ponomarev-Stepnoi and V. I. Nosov. At. Energ. (USSR), 17: 103-7 (Aug. 1964). (In Russian)

A compilation is made of experimental and calculated data on the efficiency of single boron-containing absorption rods and of systems of such rods, arranged in the side reflector of a homogeneous cylindrical thermal reactor. Good agreement is obtained in the results. Using the three-group diffusion approximation, the calculation method is generalized to the case of an arbitrary distribution of rods in the side reflector of the reactor. (tr-auth)

42946 OPTIMUM REACTOR SCRAM CONDITIONS. Yu. P. Petrov. At. Energ. (USSR), 17: 144-5(Aug. 1964). (In Russian)

Optimal conditions for reactor scram are examined, assuming that reactivity depends only on xenon (^{135}Xe) content and that processes in a reactor are described by a set of differential equations in terms of reactor power and xenon and iodine concentrations. The problem of minimizing scram time and also minimizing power loss and consequent useless fuel consumption is considered. A graph of optimal conditions for scram is given. (M.J.T.)

42947 THERMAL UTILIZATION IN THE SQUARE LATTICE CELL. A. Sauer (Allgemeine Elektricitats AG, Frankfurt am Main). J. Nucl. Energy, Pts. A & B, 18: 425-47(Aug. 1964). (KEA-125)

The thermal utilization in square lattices with cylindrical fuel rods is calculated using a simplified form of integral transport theory. The results for tight lattices were comparable in accuracy to Monte Carlo calculations. (D.C.W.)

42948 DISADVANTAGE FACTORS IN CYLINDRICAL CELLS. J. L. Alvarez Rivas and F. J. Olarte (Junta de Energia Nuclear, Madrid). J. Nucl. Energy, Pts. A & B, 18: 449-52(Aug. 1964).

The disadvantage factors in circular, three-region (fuel, cladding, moderator) cells of D_2O lattices were calculated using diffusion theory. The results were compared with experimental results for single rods and rod clusters. (D.C.W.)

42949 SOME GEOMETRICAL FACTORS FOR REACTIVITY CALCULATIONS. Jeffery Lewins. Nucl. Energy, 220-5(Aug. 1964).

Some geometric correction factors, which are derived from one-group diffusion theory, are collected and summarized for use in reactivity calculations. The results are intended to be useful as a numerical improvement to simple models and results where one-group diffusion theory is adequate, and as a guide to the extent of attention that must be given to geometrical effects in various particular types of problems. Perturbation theory is introduced, as it is weighting function that minimizes the error to the first-order approximation where the calculation is based on the unperturbed flux shape. (T.F.H.)

42950 A PULSED SOURCE METHOD FOR DETERMINING THE NEUTRON ABSORPTION CHARACTERISTICS OF HETEROGENEOUS REACTOR CELLS. Boyd Walker Johnson. Thesis, Raleigh, N. C., North Carolina State Univ., 1963. 116p.

Small, cell-sized multiplying systems of natural uranium rods in heavy water, D_2O, were studied using a pulsed neutron source. The main objective of this work was to test the pulsed neutron method proposed for investigating the manner in which the absorption characteristics of 1, 3, and 7-rod cluster systems changed as the rod spacing in the clusters was varied. From the experimentally observed absorption behavior, values of diffusion parameters for each geometry and spacing, needed for accurate reactor calculations and predictions, were found. These cluster parameters include the effective absorption cross section, thermal lifetime, thermal diffusion length-squared, effective cluster absorption coefficient, and the equivalent disadvantage factor of a single fuel rod. The cluster systems studied covered an average buckling range of from about 400 to 700 m^{-2}. The method used was first to obtain a value of the system fundamental decay constant, λ_{111}, by analyzing the decaying neutron flux in each system, using the pulsed source and a time analyzer. This was done for a series of system sizes, or bucklings, B^2, for each cluster type and radial spacing. Next, this series of λ_{111}-B^2 values was analyzed over a limited B^2 range, in which the system behaved like a pure absorber, to yield the system infinite medium absorption probability. This absorption probability was used in the framework of a theoretical expression derived from diffusion theory in order to obtain values, for each cluster type and size, of the parameters stated above. The parameter values were then graphed as functions of the cluster spacings to give the desired spatial behavior of these diffusion parameters. The parameter results were then compared to previously published parameter values for comparable systems, and the validity of the method used was evaluated. It was concluded that the values of the absorption characteristics found are valid, and thus that the method is also valid. (Dissertation Abstr., 25: No. 1, 1964)

42951 SPATIALLY DEPENDENT TRANSFER FUNCTION OF NUCLEAR SYSTEMS BY CROSS CORRELATION METHODS. Chester Dyer Kylstra. Thesis, Gainesville, Fla., Univ. of Florida, 1963. 176p.

The concept of a transfer function for a nuclear system is extended to include spatial effects. The general equation is derived using the time-dependent Fermi age and diffusion theories for a single-region, isotropic, homogeneous medium. The general transfer function equation is specialized for several cases, including the case of a point source in a cylindrical medium. Theoretical curves are calculated for multiplying and non-multiplying media and compared with the commonly used lumped parameter transfer function. The results indicate, in general, that the lumped parameter model predicts the correct behavior of the nuclear system only if the output detector is located a specific distance from the source. Experiments were performed on light and heavy water subcritical assemblies to measure the spatially dependent transfer function between two detectors. Two neutron detection systems provided analog output voltages proportional to the neutron density fluctuations at different locations in the assembly. The data were analyzed by cross correlating the two outputs and calculating the cross power spectra. Statistical equations are developed which show that the transfer function may be obtained by computing the ratio of the cross power spectra for two different runs, with one detector moved to a new location for the second run. A comparison of the experimental and theoretical transfer functions provided inconclusive evidence as to the validity of the theoretical model. (Dissertation Abstr., 25: No. 1, 1964)

42952 DEVICE FOR MEASURING THE NEUTRON FLUX IN A NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,337,153. July 29, 1963. Priority date Oct. 27, 1961, Great Britain.

The device is composed of an irradiation element enclosing a fluid quantity, which is activated according to the local neutron flux value. The activated fluid is removed via a sampling line in such a way that the time during which the fluid remains within the element is long with respect to the time the fluid needs for passing the sampling line before reaching an instrument for measuring the activity of the fluid induced by neutron irradiation. The element has a fluid inlet and an outlet, the latter communicating with the sampling line. It is made of a magnesium alloy casing into which a series of porous dividing walls are placed so that the fluid flow successively passes through all the walls. The irradiation element can be lowered by a cable into different levels of a reactor channel. The sampling line is enclosed within the cable, while the inlet communicates with the reactor channel so that the reactor coolant may serve as the fluid to be activated. (IIB)

Design and Feasibility

42953 (TID-7050(p.531-5)) REACTOR DESIGN TECHNIQUES. R. S. Wick, ed. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Applications of theoretical concepts on slowing-down and thermal spectra to determine the nuclear characteristics of reactors are discussed. (R.E.U.)

42954 ATOMIC PILES. (to United Kingdom Atomic Energy Authority). French Patent 1,208,777. Sept. 14, 1959. Priority date Nov. 25, 1957, Great Britain.

A reactor core was designed that consists of a lattice of parallel, hexagonal core units, placed at a distance from each other so that coolant channels are formed between adjacent lateral faces. Each core unit comprises a prismatic, hexagonal, steel tube filled with BeO while a slab of enriched UO_2 is inserted between each of the tube walls and the BeO. (NPO)

42955 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,333,954. June 24, 1963. Priority date July 3, 1961, Great Britain.

In the tank of a nuclear reactor a liquid coolant was enclosed forming a free level and above this level was a pressurized gas. The coolant flows downwards through the reactor core producing a considerable pressure loss. If a region of the free liquid level is separated from the rest, e.g., by a dividing wall reaching downward into the coolant mass, it may occur that, owing to the pressure loss, the level in the region is lowered and the gas is mixed with the coolant. In order to avoid this, the adjacent gas space of the separated region of the free level encloses a gas separated from the remaining gas. The dividing wall may have the form of a tubular casing and enclose the control mechanism. The gas pressure in the casing may also be controlled so that the fluid level inside the casing rises above the coolant level outside, while the casing is adapted to be be placed over a fuel element to be discharged, so that the element may be lifted into a fluid filled spaced within the casing. (IIB)

42956 NUCLEAR REACTOR IN WHICH THE FISSION IS EFFECTED IN A SELF-SUSTAINING NUCLEAR CHAIN REACTION. (to United Kingdom Atomic Energy Authority). French Patent 1,342,072. Sept. 23, 1963. Priority date Jan. 11, 1962, Great Britain.

A reactor core consisting of fuel elements adapted to rotate with respect to the others and each consisting of an active section and a moderator section, both eccentrically disposed with respect to the rotation axis, is described. Such rotations provoke a change in the slowing-down of neutrons to thermal energies, which serves for reactivity control. The elements are drum shaped and consist of three sectors forming an active region, a neutron absorbing region, and a moderating region. The reactor core is constituted by six such elements surrounding a single central element formed by an active assembly. This control process is especially adapted for the compensation of reactivity losses due to fuel burnup. (IIB)

42957 NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,344,150. Oct. 14, 1963. Priority date July 5, 1962, Great Britain.

Liquid-cooled reactors in which the coolant enters the reactor vessel by lateral inlet ducts and flows down an annular interspace between the reactor core and the vessel wall before entering the core from the bottom are discussed. During an accident gases and vapors may be formed within the reactor vessel, but it is important that the core always remains immersed in the cooling liquid. In order to ensure this, means are provided preventing the reversing of the coolant flow. These means are formed by check valves provided in a horizontal dividing wall disposed at the same level as the reactor core top and separating the annular interspace into an upper and a lower compartment. (IIB)

42958 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,344,738. Oct. 21, 1963. Priority date July 5, 1962, Great Britain.

In a nuclear reactor a heat transmitting fluid flows within a system of tubes in direct contact with the fuel elements so as to be separated from the reactor coolant flowing outside the tubes through the reactor core. This heat transmitting fluid is a liquid moderator and is pressurized in order to prevent boiling. The pressurizer used is a closed space in the shape of a helicoidal duct disposed within the annular space formed between the reactor core and the pressure vessel. The lowest turn of the duct communicates with the circuit of the heat-transfer fluid, while means are provided for the injection of a pressurized gas in that chamber so that a free level of the heat-transfer fluid is formed. In case of tilting against the vertical, this disposition ensures that the lowest turn remains always liquid filled, which is important for use in naval reactors. (IIB)

42959 NUCLEAR REACTOR AND OPERATING PROCESS FOR SUCH A REACTOR. (to Babcock and Wilcox Co.). French Patent 1,347,278. Nov. 18, 1963. Priority date Dec. 8, 1961, United States.

The design of a reactor so that the reactivity is controlled by changing the hydrogen concentration within the core is described. The moderator is partially formed by a hydrogen-containing vapor, so that reactivity may be controlled by changing the hydrogen concentration of this vapor. If the reactor consists of fertile material this change in hydrogen concentration results in a change of distribution of the neutron absorption between the fissile and the fertile material. The change of hydrogen concentration is controlled by changing the density of the vapor. The reactor may consist of a pressure vessel with a series of tubes containing the fuel and a circulating coolant, while the space outside the tubes is occupied by the moderating vapor. If the coolant pressure has to be higher than the pressure that leads to adequate moderating characteristics, a gas or vapor without essential moderating characteristics may be added to the moderating vapor. (IIB)

42960 PRESSURE TUBE REACTOR. (to Societe Indatom). French Patent 1,349,456. Dec. 9, 1963. Filed Dec. 7, 1962.

A nuclear reactor was designed with a plurality of parallel ducts passing through a space enclosed by the biological shield and enclosing a tank for the moderator. The tank wall is extended at its top and bottom surfaces by tubular portions enclosing the end portions of said ducts and passing with them through the biological shield. Each duct is made up of two concentric tubes forming between them an annular interspace containing a thermal insulating fluid. These tubes and the tubular extensions of the reactor tank are interconnected by means ensuring the fluid tightness of the system and disposed outside the biological shield. The coolant is an organic liquid while heavy water is used as a moderator. Preferably the tubular extensions and the ducts are provided with inlets and outlets for the circulation of the moderator and the thermal insulating fluid, respectively. (IIB)

42961 STEAM-WATER MIXING DEVICE FOR STEAM-COOLED REACTOR. A. J. Goldman and G. Breidenbach (to U. S. Atomic Energy Commission). U. S. Patent 3,150,053. Sept. 22, 1964.

A device was developed for mixing steam and water in a fog-cooled nuclear fission reactor. The mixing device is located in the entrance of each fuel coolant tube within the reactor core. The device consists of a diffuser section for receiving steam having a multiplicity of openings through which water surrounding the section sprays into the steam. The water and steam are maintained at pressures having a particular relationship. (AEC)

42962 REACTOR. Herbert E. Metcalf (to U. S. Atomic Energy Commission). U. S. Patent 3,150,055. Sept. 22, 1964.

A nuclear reactor incorporating a hollow hub of beryllium having fastened to it a plurality of generally radial blades formed of a thin layer of a fissionable material sandwiched between layers of beryllium and a volute casing of beryllium having an inlet and an outlet for air enclosing the rotor is described. (AEC)

42963 NUCLEAR REACTOR. Alvin Radkowsky (to U. S. Atomic Energy Commission). U. S. Patent 3,154,471. Oct. 27, 1964.

A seed-blanket pressurized-water reactor, consisting of a depleted blanket in which a plurality of highly enriched seed elements are disposed, was designed. Each seed element is neutronically critical without reliance on coupling from other seed elements. Also, a movable fuel control mechanism is associated with each seed element. The core is thermally and hydraulically designed for all power to be initially produced in the seed elements. (AEC)

Fuels

42964 (EUR-1850.e(p.163-71)) FUEL ELEMENT FABRICATION AND IRRADIATED FUEL REPROCESSING IN THE COMMUNITY. A. Baruffa and W. Vinck (European Atomic Energy Community).

A review of fuel cycle process development and status is presented. It is noted that fuel element manufacturing in the Community is at a critical stage. The Commission's activity is directed toward the creation of optimum conditions for fuel element manufacture. In fuel reprocessing the Community has the ability to design and construct radiochemical processing plants; however, operating experience is limited. (J.R.D.)

42965 (EXP-NRX-20605) A COLLAPSE MODE OF FAILURE IN POWDER-FILLED FUEL ELEMENTS. M. A. Feraday and G. H. Chalder (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1964. 24p. (AECL-1894; CONF-315-3)

From Norton Company's Symposium on the Technology of Powder Filled UO$_2$ Fuel Elements, Worcester, Mass., Nov. 1963.

Two swaged fuel elements containing crushed, fused UO$_2$ powder were irradiated in a pressurized water loop at high heat ratings. The fuel elements were 2.0 cm in diameter and were sheathed in nickel-free Zircaloy-2 of 0.038-cm thickness. One element failed when the sheath ruptured at the top of a longitudinal ridge in the sheath after a burnup of approximately 2550 Mwd/teU. No evidence was found that outgassing of the UO$_2$ contributed to the failure. Dimensional and structural changes observed in the fuel elements led to the conclusion that ridging of the sheath resulted from the action of coolant pressure on the diametral clearance formed by sintering and shrinkage of the UO$_2$. Failure resulted due to severe local deformation accompanying one or more power cycles following ridge formation. (auth)

42966 (PAN-528/IX) PODSTAWOWE PROBLEMY EKONOMICZNE PRZEMYSLU PALIW JADROWYCH. (Fundamental Economic Problems of The Nuclear Fuel Industry). T. Wojcik (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Apr. 1964. 31p.

On the basis of available information on the investments for the building of nuclear fuel industry and on the cost of fuel production, an analysis of the relation between the specific investments and the productive capacity of the respective establishments, as well as between the value of the production, the investments, and the manpower employed at particular stages of industrial fuel cycles was carried out. The investments and the necessary manpower were determined for the whole program of the fuel industry, corresponding to the needs of the types of nuclear power stations examined. The amount and the structure of the fuel cost in particular types of power stations were studied. It is stated that the examination of the economic problems of nuclear fuel industry constitute one of the elements of the economic analysis of nuclear power and of particular types of such power stations. (auth)

42967 (TID-7050(p.751-800)) DEPLETION METHODS. W. A. Northrop (Knolls Atomic Power Lab., Schenectady, N. Y.); and F. R. Urbanus (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Theories governing depletion effects in power reactors, and methods of applying these theories to reactor design are discussed. The constant power and constant flux methods are discussed. The depletion of natural uranium in pressurized-water reactors is discussed separately. (R.E.U.)

42968 (UJV-706/62) TERMOKINETIKA REAKTOROVÝCH PALIVOVÝCH ČLÁNKÚ TVARU KRUHOVÉ TYCE, TRUBKY A SVAZKU KONCENTRICKÝCH TRUBÉK S TYČÍ V OSE. ČÁST I. TEORETICKÉ ÚVAHY. (Thermokinetics of Reactor Fuel Assemblies in the Shape of Round Rods, Tubes, and Bundles of Concentric Tubes With Axial Rods. Part I. Theoretical Considerations). P. Novotný (Československá Akademie Věd. Ustav Jaderněho Výzkumu, Řež). [1959]. 75p.

An analysis of the thermokinetic relations in reactor fuel assemblies in the shape of round rods, tubes, and bundles of concentric tubes with axial rods is presented. It contains a solution for the thermal field for the usual case. With assemblies of independent round rods or tubes, the influence of variation of the heat conductivity of the fuel with temperature and the same for fuel of oxide type and also the variation of the bulk density of heat sources in the fuel with the radius is examined. With assemblies in the shape of tubes with axial rods, conditions were found for optimum thermokinetic relations. A solution is indicated for the empirical calculation for tubes, then it carried through up to the final result for the concrete case of the assembly of two concentric tubes with an axial rod. (TTT)

42969 DETERMINATION OF THE OPTIMUM BURNUP AND ENERGY OF NUCLEAR FUEL. Yu. N. Koryakin, V. V. Batov, and V. G. Smirnov. At. Energ. (USSR), 17: 94-7(Aug. 1964). (In Russian)

A method for determining the economic efficiency of reactor fuels is given on the basis of design costs. The expression obtained for the fuel costs in the generation of electric energy permits the tracing of the concomitant effect on the economics of using nuclear fuel. As an example, fuel costs for a reactor of the Beloyarskii type are developed. (M.J.T.)

42970 PLUTONIUM IN THERMAL REACTORS. H. S. Arms (English Electric Co. Ltd., [Whetstone, Leics, Eng.]), P. D. Potter, J. H. Foley, and R. H. W. Stace. Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 2: 333-52.

The use of Pu in thermal reactors is reviewed. Discussion is presented on plutonium fuels in particular thermal reactors, fabrication of plutonium fuels, reprocessing of plutonium fuels, physics of plutonium in thermal reactors, self screening in plutonium isotopes, spatial effects basic nuclear data, methods of calculation, and reactor design. 66 references are included. (P.C.H.)

42971 NUMERICAL CALCULATION OF EXTENDED SURFACE EFFICIENCY. Maurizio Cumo (Comitato Nazionale per l'Energia Nucleare, [Rome]), Sergio Lopez, and G. C. Pinchera. New York, American Inst. of Chemical Engineers, 1964, Preprint No. 31, 27p. $0.50. (CONF-644-11)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

Thermal performance of an extended surface and the effect of a variation in geometry on it are discussed in order to determine that geometry which will reduce manufacturing difficulties satisfactorily and maximize thermal performance of the finned claddings of fuel elements and other extended surfaces. An array of fins is taken as being better dimensioned if the method of the maximum finning ratio is followed rather than the traditional minimum fin weight method. A mathematical treatment is outlined. (C.E.S.)

42972 FUEL ELEMENT FOR NUCLEAR REACTOR. Maurice Gauthron (to Commissariat a l'Energie Atomique). British Patent 969,889. Sept. 16, 1964. Priority date Sept. 5, 1962, France.

A fuel element is designed with a plug which has a reduced tendency to creep under load, e.g., at the bottom of a stack of fuel elements. The fuel element comprises a fissile body housed in a metallic can closed by a metallic plug bearing against an abutment member. The surfaces of contact of the plug with the abutment member and the fissile body have sufficient roughness to prevent creep of the plug. Two embodiments of the fuel element are described. (D.L.C.)

42973 NEW DISPOSITION TO IMPROVE HEAT TRANSFER. (to Commissariat a l'Energie Atomique). [First] Add. No. 76,456 to French Patent 1,200,408. Sept. 11, 1961. Filed May 22, 1959.

The application of biconical fuel units is considered. Biconical fuel pins were assembled in a bundle or cylindrical or truncated fuel elements of different diameter were juxtaposed to give a biconical unit. (NPO)

42974 IMPROVEMENTS IN COOLING BY FLUID FLOW ALONG JACKETS WITH LONGITUDINAL FINS. (to Commissariat a l'Energie Atomique). French Patent 1,219,325. Dec. 28, 1959. Filed Dec. 23, 1958.

To improve the heat transfer to the coolant, cylindrical fuel elements with longitudinal fins were provided with a number of spaced, profiled rings, which contact the periphery of the fins. The fins have slits in the depression zones that are created by the rings. The rings can be replaced by a helical band wrapped around the element. (NPO)

42975 SUPPORT DEVICES FOR FUEL ELEMENTS. (to General Electric Co. Ltd.). French Patent 1,223,824. Feb. 1, 1960. Priority date May 12, 1958, Great Britain.

Fuel units were developed which consist of a fuel element in a graphite sleeve. The crossbeam, which is situated at the bottom of the sleeve, is linked to two upwardly extending tie rods. The upper ends of the tie rods are either linked to a lifting ring or to the crossbeam of an adjacent unit. (NPO)

42976 NUCLEAR REACTORS. (to General Electric Co., Ltd.). French Patent 1,232,111. Apr. 19, 1960. Priority date Aug. 6, 1958, Great Britain.

Chains of fuel units were designed. Each unit consists of a graphite carrier sleeve in which a fuel element is supported. The crossbeam of each unit is linked to two longitudinally extending tie rods, the upper and lower extremities of which are linked to an upper and a lower universal joint respectively. Two adjacent units have one universal joint in common. (NPO)

42977 IMPROVEMENT IN NUCLEAR REACTOR ELEMENTS. (to Societe Anonyme d'Etudes et Realisations Nucleaires Sodern). Second Add. No. 77,484 to French Patent 1,238,281. Jan. 29, 1962. Filed Apr. 4, 1960.

A fuel element is described, which consists of a silica jacket in which a number of juxtaposed fuel units are axially mounted. The units are spaced from their jacket by means of alumina spacers, the extremities of which are provided with SiO_2 shock absorbers. Each fuel unit is constituted by a number of fuel rings, strung on a graphite spine and enclosed in a metal, e.g. W, network. (NPO)

42978 NEW METHOD AND DEVICE FOR EXTRACTING HEAT FROM NUCLEAR FUEL ELEMENTS BY MEANS OF TRANSVERSAL FINS. (to Commissariat a l'Energie Atomique). French Patent 1,241,855. Aug. 16, 1960. Filed Aug. 13, 1959.

Devices for creating a transversal fluid flow between closely spaced, thin, transversal fins of a cylindrical fuel element are described. One of the devices consists of a sleeve that closely surrounds the fuel element and provided with inlet and outlet orifices. A second type of devices consists of zigzag-shaped, circumferential guide blades that are distributed along the length of the fuel element. (NPO)

42979 NEW METHOD AND DEVICES FOR EXTRACTING HEAT FROM NUCLEAR FUEL ELEMENTS BY MEANS OF TRANSVERSAL FINS. (to Commissariat a l'Energie Atomique). First Add. No. 77,447 to French Patent 1,241,855. Jan. 22, 1962. Filed Apr. 6, 1960.

A device for creating a transversal fluid flow between the transversal fins of a fuel element consists of a number of longitudinal units, distributed over the circumference of the fuel element. Each unit is composed of a straight strip with transverse, parallel, triangular, wedge-shaped guide blades. The strip runs along a generatrix of the fuel element while the blades are inclined with regard to the axial direction of element and their bases touch the periphery of the fins. (NPO)

42980 NEW METHOD AND DEVICES FOR EXTRACTING HEAT FROM NUCLEAR FUEL ELEMENTS BY MEANS OF TRANSVERSAL FINS. (to Commissariat a l'Energie Atomique). Second Add. No. 78,150 to French Patent 1,241,855. May 2, 1962. Filed July 26, 1960.

The device for creating transversal flow between transversal fins of fuel elements was improved by cutting the base corners of the triangular guide blades. This gave a gain in pumping power and increased the thermal output. (NPO)

42981 NEW METHOD AND DEVICES FOR EXTRACTING HEAT FROM NUCLEAR FUEL ELEMENTS BY MEANS OF TRANSVERSAL FINS. (to Commissariat a l'Energie Atomique). [Third] Add. No. 79,227 to French Patent 1,241,855. Oct. 1, 1962. Filed Feb. 15, 1961.

The device for creating transversal fluid flow between transversal fins on fuel elements was further improved by providing the fins with radial slits, either situated in the inlet regions, i.e. near the guide blades, or in the outlet regions, i.e. between the guide blades. These slits gave a substantial decrease in pressure losses. (NPO)

42982 NUCLEAR REACTOR FUEL ELEMENTS. J. A. Ransohoff. French Patent 1,253,399. Jan. 2, 1961. Priority date Jan. 8, 1959, United States.

Fuel rods, plates, or tubes present in cross section a non-uniform chemical composition and/or degree of enrichment. Thus the fuel of the peripheral part can be more highly enriched than the fuel of the central part and/or the central part can consist of ceramic fuel and the peripheral part of metallic fuel. It was concluded that this disposition leads to a higher admissible power level in the reactor. (NPO)

42983 IMPROVEMENTS IN FUELS FOR NUCLEAR REACTORS. (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). French Patent 1,267,602. June 12, 1961. Priority date Sept. 18, 1959, Great Britain.

A fuel element was developed, which consists of a column of fuel pellets in a cylindrical jacket. The jacket is pressed either into peripheral grooves in the central part of each pellet or in peripheral grooves that are formed by the truncated ends of the pellets. Axial displacements of the pellets are thus prevented. (NPO)

42984 METHOD AND DEVICE FOR IMPROVING THERMAL EXCHANGE. (to Commissariat a l'Energie Atomique). French Patent 1,272,050. Aug. 16, 1961. Filed July 6, 1960.

Finned fuel elements were designed in which the fins shape elementary channels. A more regular temperature distribution could be obtained if the heat exchange surfaces at the fluid inlets of the elementary channels were reduced with respect to those at the fluid outlets. A cylindrical fuel element was therefore developed with square transversal fins that are camfered at their corners and with rows of triangular guide blades at the square sides. A cylindrical fuel element with spaced longitudinal sections of parallel curved fins, the fins of adjacent sections being oppositely directed and the height of its fin increasing in the direction of the coolant flow, was also designed. (NPO)

42985 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,273,896. Sept. 11, 1961. Priority date July 14, 1960, Great Britain.

A fuel element was designed in which a separate, annular piece of fuel is placed in an interior, circumferential groove in the vicinity of the joint between sheath and end cap. This arrangement promotes the early detection of leaks in the fuel element. The piece of fuel preferably consists of uranium foil which is so shaped (e.g. perforated) that it does not completely fill the groove. (NPO)

42986 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). [First] Add. No. 80,212 to French Patent 1,273,896. [Sept. 11, 1961]. Priority date July 18, 1960, Great Britain.

An arrangement for early detection of leaks in a fuel element is described. Two or more superposed U foils may be used in the groove in the vicinity of the joint between sheath and end cap in a fuel element or the metallic foil may be replaced by a sectionalized UO_2 ring. A communication between the circumferential groove and the interior of the fuel element can be achieved by means of longitudinal grooves. (NPO)

42987 IMPROVEMENTS IN NUCLEAR REACTORS AND IN THEIR FUEL ELEMENTS. (to Babcock and Wilcox Ltd.). French Patent 1,274,370. Sept. 18, 1961. Priority date Aug. 30, 1956, Great Britain.

Fuel units are described that consist of a tubular graphite sleeve that supports an axial, finned fuel rod. The rod has three equidistant longitudinal baffles, which rest on an internal shoulder at the bottom of the sleeve, touch the internal wall of the sleeve, and are fastened to the top of the sleeve. The top of the rod has lifting arms. The internal diameter of the sleeve decreases from bottom to top and the external diameter remains constant. In loading a reactor channel such differently dimensioned units are stacked so that a coolant channel, which converges from the the bottom to the top of the core is formed by the sleeves. The extremities of the sleeve form two insulated, protruding, copper rings, the top and bottom rings are electrically connected. In stacking fuel units the top and bottom rings of adjacent units come to rest upon each other. A fuel rod thermocouple is connected with a pair of copper rings, while the rings at the top of the column are connected with an indicating apparatus. (NPO)

42988 NUCLEAR FUEL ELEMENTS AND THEIR METHOD OF MANUFACTURE. (to General Electric Co.). French Patent 1,289,111. Feb. 19, 1962. Priority date May 9, 1960, United States.

End caps of nuclear fuel elements were provided with a cavity that communicated with the interior of the fuel elements and was filled with a permeable metallic material (Zr, Nb, Ti, Y, or Hf) in the form of powder, granules, chips, etc. This material reduces the pressure increase during irradiation of the fuel element, while the specific structure of the end caps reduces the decrease in strength during its manufacture. (NPO)

42989 IMPROVEMENTS IN FUEL JACKETS. (to Babcock and Wilcox Ltd.). French Patent 1,289,281. Feb. 19, 1962. Priority date May 17, 1960, Great Britain.

Cylindrical fuel elements were designed with helical fins that are disposed according to a herringbone pattern. The fins of adjacent sections terminate at least at the outlet side of the elementary channels formed by the fins in a common longitudinal reinforcing rib that is an integral part of the jacket. The bottoms of the elementary channels are longitudinally incurvated while radial extension pieces can be fixed to the reinforcing ribs to form longitudinal baffles. Instead of being helical the fins can be so curved that they have a more or less axial direction. (NPO)

42990 IMPROVEMENTS IN NUCLEAR FUEL ELEMENTS. (to General Electric Co. Ltd.). French Patent 1,290,718. Mar. 5, 1962. Priority date June 1, 1960, Great Britain.

Rod-type fuel elements were designed, which are provided at their extremities with a separate, either flaky or porous, fuel pellet, which is insulated from the end cap and from the main fuel. In consequence of their higher temperature these pellets are preferentially oxidized by the coolant should a leak in the sheath occur; the resulting swelling lifts the end cap. Thus the fault in the fuel element can be more easily detected. (NPO)

42991 FUEL ELEMENT FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,294,074. Apr. 9, 1962. Priority date July 1, 1960, Great Britain.

Fuel rods were designed, which consist of a column of fuel pellets in a cylindrical jacket. The end faces of the pellets present a central concavity, the depth of which is $^1/_{100}$ to $^1/_{1000}$ of the height of the pellets while its diameter is 50 to 80% of the diameter of the pellet. Said concavities take up to the axial dilation of the column of pellets. (NPO)

42992 CONTAINER FOR FUEL PLATES. (to Commissariat a l'Energie Atomique). French Patent 1,295,976. May 7, 1962. Filed May 2, 1961.

A fuel plate assembly is described in which the individual fuel plates are easily replaceable. The container consists of two perforated side plates, which are connected with a tubular end box; the side plates are further connected with peripheral cross strips that are spaced along their length. The strips and the end box present inwardly and upwardly extending teeth respectively. Fuel plates are slipped between the teeth and held in position by means of a clamping device that is finally fastened in the top of the container. (NPO)

42993 IMPROVEMENTS IN HETEROGENEOUS NUCLEAR REACTORS. (to General Electric Co. Ltd.). French Patent 1,296,941. May 14, 1962. Priority date Aug. 19, 1960, Great Britain.

A method was developed for producing a stronger local cooling of the central part of a vertical column of fuel elements in order to increase surface temperature at the other parts of the column. Modified fuel units were used in vertical rows of perforations in their sleeves. The modified units were applied in the central part of longitudinally grooved fuel channels. The grooves extended from the bottom up to the center and were aligned with the rows of perforations. (NPO)

42994 FUEL ELEMENT FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,298,010. May 29, 1962. Priority date July 12, 1960, Great Britain.

A fuel rod, consisting of a column of UO_2 pellets in a stainless steel jacket was designed. To facilitate their insertion in the jacket the pellets were truncated. Moreover their end faces were dished to allow for a certain axial dilation of the column. (NPO)

42995 IMPROVEMENTS IN FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Combustion Engineering, Inc.). French Patent 1,299,978. June 18, 1962. Priority date Dec. 5, 1960, United States.

A fuel element was designed with a duplex jacket, the outer part consisting of Al, Zr, Be, Nb, or stainless steel and the inner part of an alloy or dispersion of B in the metals. The duplex jacket can be made by co-extrusion. (NPO)

42996 FUEL ELEMENT FOR NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,303,026. July 30, 1962. Filed July 18, 1961.

A fuel element was developed for a high-temperature gas-cooled reactor. The fuel element has a duplex can, the inner part of which consists of Zr, Al, or Be and has a thickness of 1 to 2 mm, while the outer part consists of $^{18}/_8$ stainless steel, Mo steel, or Ni–Cr $^{80}/_{20}$ and has a thickness of 0.1 mm. (NPO)

42997 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Societe d'Etude de la Propulsion par Réaction). French Patent 1,303,064. July 30, 1962. Filed July 25, 1961.

A fuel element was designed that consists of a column of spaced, parallel, circular, curved, fuel plates on a central supporting tube. Each plate has three oblique incisions at its circumference. The fuel element is axially placed in a reactor channel and the coolant is made to flow both through the supporting tube and around the plates, the action of the incisions being to direct the coolant between the plates. (NPO)

42998 FUEL ELEMENT FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,303,334. July 30, 1962. Priority date Oct. 10, 1960, Great Britain.

Polyzonal spiral fuel element with helical fins and longitudinal splitters are described. To improve their stability in the coolant flow, three of the splitters have L-shaped sections at their extremities over different parts of their lengths, the L's being bent in the same direction. (NPO)

42999 FUEL ELEMENT FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,303,828. Aug. 6, 1962. Priority date Oct. 21, 1960, Great Britain.

A fuel element was designed, which has a region of preferential oxidation should a leak in the jacket occur. The resulting swelling provokes fissuring of the jacket, which facilitates the leak detection. Various embodiments are given. (NPO)

43000 TUBULAR BODIES PROVIDED WITH FINS. (to United Kingdom Atomic Energy Authority). French Patent 1,308,519. Sept. 24, 1962. Priority date Dec. 28, 1960, Great Britain.

The fins on cylindrical fuel elements were disposed according to a herringbone pattern, adjacent sections possibly being separated by anti-flexion ribs. Jackets having this fin pattern were manufactured either by extrusion or by milling. (NPO)

43001 FUEL ELEMENT IN NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,312,302. Nov. 5, 1962. Priority date Jan. 26, 1961, Great Britain.

Reinforcement of finned fuel rods against flexing is discussed. Polyzonal spiral fuel rods were reinforced with annular braces with radially outstanding ears consisting of two parallel plates. The braces closely embrace the helical fins while the longitudinal splitters are each fastened between the two plates of an ear. Finned fuel rods without splitters e.g. fuel rods on which the fins are disposed, according to a herringbone pattern, are reinforced with the same type of braces, coupling plates then being used that slide into longitudinal slots in the jacket on the one side and are fastened between the plates of the ears on the other side. In the latter case, the ears act as radial spacer arms. (NPO)

43002 FUEL ELEMENT UNITS FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority) French Patent 1,316,161. Dec. 17, 1962. Priority date Mar. 27, 1961, Great Britain.

A fuel unit is described, which consists of a tubular graphite sleeve that carries an axial fuel rod. The rod presents helical fins and longitudinal baffles, the baffles clutching in longitudinal slots in the sleeve. The top of the rod carries radial arms which clutch in the same slots, thus preventing rotation of the rod. (NPO)

43003 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,316,822. Dec. 26, 1962. Priority date Mar. 3, 1961, Great Britain.

The Dounreay tubular fuel element, which has an inner V and an outer Nb jacket, while Na or Na–K is applied as an internal heat-transmission agent, is described. The free space at the top of the element, which is the reservoir for the heat-transfer agent, is provided with a getter material, e.g. a Zr cylinder, to remove impurities which might damage the jackets. This free space is in open communication with the space outside the fuel element. (NPO)

43004 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,316,823. Dec. 26, 1962. Priority date Mar. 6, 1961, Great Britain.

Polyzonal spiral fuel elements, with helical fins and longitudinal splitters, are described. To improve their stability in coolant flow the splitters had bent outer edges, so that in cross section they look like a swastika. (NPO)

43005 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,317,878. Jan. 2, 1963. Priority date Mar. 28, 1961, Great Britain.

A fuel element was designed that consists of a column of tubular fuel sections within a cylindrical jacket. Each section is provided with a radial slit that extends over the full height and radius of the section. The cavities thus present in the interior of the element are filled with a pressurized gas (H_2,He). The jacket is made of a traction- and creep-resistant material, e.g. Nimonic, and its wall thickness should be at least $^1/_{10}$th of its diameter. A good lasting contact between jacket and fuel was achieved. (NPO)

43006 NUCLEAR FUEL ELEMENT. (to United Kingdom Atomic Energy Authority). French Patent 1,318,083. Jan. 7, 1963. Priority date Mar. 24, 1961, Great Britain.

Calder Hall type fuel elements, the end plugs of which are screwed in an edge welded to the sheath, are described. In order to protect the weld from damage during charging operations, the element is provided with bell-shaped end pieces that are screwed in the plugs and welded to the flank of the sheath. The end pieces present the well-known conical recess and conical protrusion. (NPO)

43007 FUEL ELEMENT JACKET. (to English Electric Co. Ltd). French Patent 1,319,037. Jan. 14, 1963. Priority date Apr. 6, 1961, Great Britain.

The stabilization of a polyzonal spiral fuel element during reactor operation by exerting on it a transversal coolant force is discussed. The force is created by placing deflecting blades on the transversal extremities of the splitters at the downstream side, possibly in combination with L-shaped splitters. (NPO)

43008 FUEL ELEMENT FOR NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,321,606. Feb. 11, 1963. Filed Feb. 9, 1962.

Cylindrical, cruciform fuel elements were designed with 3 to 6 radial arms and an axial cavity. The cavity is either filled with an inert gaseous or refractory material or acts as an interior coolant channel. The dimensions of the cavity and of the arms are so chosen as to increase the external cooling surface and to diminish and equalize material thickness. (NPO)

43009 NUCLEAR FUEL ELEMENTS. (to Commissariat a l'Energie Atomique). French Patent 1,321,607. Feb. 11, 1963. Filed Feb. 9, 1962.

Fuel units are described that consist of a graphite sleeve that carries a finned fuel element. The fuel element has a cruciform or star-shaped cross section while the interior wall of the sleeve has a transversal outline that delimitates a number of lobes. The internal protrusions between the concavities of the sleeve cooperate with the arms of the fuel element to fasten the latter and to create a number of peripheral coolant channels. The lateral faces of the fuel element have helical fins, which create turbulences in the channels. (NPO)

43010 FUEL ELEMENT FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,322,729. Feb. 18, 1963. Priority date May 24, 1961, Great Britain.

A fuel element of the Bradwell type was provided with a thermocouple, the cable of which contains a section of reduced diameter. Thus by exerting traction on the thermocouple cable it can be intentionally ruptured prior to discharging operations. Two designs are given, both presenting security means that prevent rupture of the cable during normal reactor operation. (NPO)

43011 IMPROVEMENTS IN FUEL ELEMENTS. (to Commissariat a l'Energie Atomique). French Patent 1, 323,725. Mar. 4, 1963. Filed Mar. 2, 1962.

A fuel element was developed, which consists of: a fuel core of UC or UC_2 to which Zr or ZrC can be added; a sheath, having a wall thickness less than 0.3 mm, of an Fe–Al alloy with an Al content of 13 to 40 wt to which Be or Si can be added; and a diffusion barrier between the core and the sheath consisting of Cr, Zr, Nb, Y, Be, or Cu or their oxides, Al_2O_3, MgO, or C. The fuel element can be provided with radial spacer arms of graphite. (NPO)

43012 SUPPORT GRIDS FOR FUEL ELEMENTS. (to United Kingdom Atomic Energy Authority). French Patent 1,324,796. Mar. 11, 1963. Priority date June 13, 1961, Great Britain.

A support grid for an assembly of coaxial rows of fuel pins is described. The grid is composed of sectors of a circle and each sector is composed of a number of meshes, which successively surround the pins of the various rows within the sector. The meshes consist of thin metal strips that are so curved that each fuel pin is supported at three points. The meshes and sectors are joined by point welding. (NPO)

43013 DEVICE FOR THE TRANSMISSION OF POTENTIAL DIFFERENCES BETWEEN TWO FUEL ELEMENTS PILED ONE UPON ANOTHER WITHIN A REACTOR CHANNEL. (to Commissariat a l'Energie Atomique). French Patent 1,329,632. May 6, 1963. Filed Apr. 10, 1962.

An element was designed with end-plug contact units each with a central and a peripheric contact element insulated from each other. Corresponding elements at the two ends are interconnected by cables. The central contact elements are suitably supported by the end plugs via rigid shoes. The peripheric elements are supported by the upper edges of elastic pieces having a diameter equal to that of the plug. These pieces project from the contour of all the remaining portions of the element if there is no compression. The ends of the elements are provided with respectively male and female annular pieces for centering the elements one upon the other. The potential differences may be generated by thermocouples connected via a microcable box and cables to such a contact unit. (IIB)

43014 FUEL ELEMENT FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,330,406. May 13, 1963. Priority date Aug. 1, 1961, Great Britain.

The length of fuel pins, consisting of a column of ceramic fuel pellets in a jacket, was increased by subdividing the column with at least one Al_2O_3, BeO, or MgO pellet and pressing the jacket into a peripheral groove in said pellet. An assembly of such pins in a duplex graphite sleeve having spacer grids at the height of the dividing pellet is described. (NPO)

43015 FUEL ELEMENT FOR NUCLEAR REACTOR. (to Commissariat a l'Energie Atomique). French Patent 1,331,406 May 27, 1963. Filed Apr. 26, 1962.

Fuel elements are described in which the end plugs are separated from the fuel core by means of some material that has a lower thermal conductivity in the axial than in the radial sense. Thus the plugs can be kept relatively cool while the heat removal from the extremities of the fuel is not impeded. The material can consist of: a deposited disk of an anisotropic refractory ceramic (Al_2O_3 or MgO); alternate 0.2 mm layers of metal (Mg, Al, or Mn) and 0.4 mm layers of their oxides, the layers being parallel to the end face of the plug; a disk of pyrolytic graphite, separated from the fuel by a layer of a refractory oxide; or alternate solid and dished disks. (NPO)

43016 FUEL ELEMENT FOR NUCLEAR REACTOR. (to Commissariat a l'Energie Atomique). French Patent 1,331,473. May 27, 1963. Filed May 22, 1962.

In order to prevent thermal ratcheting both in longitudinal and tangential directions a fuel core was provided with a network of crossing helical grooves into which the jacket was thermopneumatically anchored. The network could either be applied to the whole fuel core or solely to its extremities. Additional transversal grooves could also be applied. The way of anchoring is considered particularly effective with polyronal spiral fuel elements. (NPO)

43017 IMPROVEMENTS IN NUCLEAR REACTORS. (to Babcock and Wilcox Ltd.). French Patent 1,332,393. June 4, 1963. Priority date Aug. 25, 1961, Great Britain.

A fuel assembly for a H_2O- and/or D_2O-cooled reactor was designed that consists of two interwoven lattices of fuel pins and moderator pins, the latter being placed in the interstices between the first. The construction of the moderator pins is analogous to that of the fuel pins with the fuel replaced by a solid or liquid moderator. In the latter case the end caps can have small orifices to enable the moderator pins to be automatically filled during reactor operation with the moderating coolant. (NPO)

43018 END CLOSURE OF NUCLEAR FUEL ELEMENT. (to Babcock and Wilcox). French Patent 1,334,817. July 1, 1963. Priority date Oct. 3, 1961, United States.

The closure of a tubular fuel element jacket was effected by means of a crucible-shaped cap, the diameter of which gradually decreased from its rim to its bottom. The cap was forced into the jacket until the edges were aligned and then edge-welded. Therefore the rim of the cap was provided with an exterior groove. (NPO)

43019 FUEL ELEMENT FOR NUCLEAR REACTOR. (to Commissariat a l'Energie Atomique). French Patent 1,336,233. July 22, 1963. Filed July 16, 1962.

Parallel fuel plates were assembled in a box-shaped container with a body of burnable poison, e.g. a plate of borated Al, in the middle part of the container walls that are parallel to the fuel plates. (NPO)

Power and Power-Breeder Reactors

Refer also to abstract 42587.

43020 (ACNP-64572) LA CROSSE BOILING WATER REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Technical Progress Report No. 4, January 1964–March 1964. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Bethesda, Md.). June 1964. Contract AT(11-1)-654. 240p.

Progress made in the development of the La Crosse Boiling Water Reactor is reported. Information is included on: in-core flux monitoring system, failed-fuel element location system, control-rod drive mechanisms, steam separation and separators, hydraulic scram tests, analog simulator design and operation for dynamic analysis of LACBWR, and the uses of variable recirculation flow rate as a means of controlling reactor power level. (N.W.R.)

43021 (ANL-6863) STABILITY CONSIDERATIONS FOR A PLUTONIUM LOADING IN EBR-I. R. R. Smith, R. O. Haroldsen, and F. D. McGinnis (Argonne National Lab., Idaho Falls, Idaho). May 1964. Contract W-31-109-eng-38. 57p.

The feedback function and transfer function measurements for EBR-I, Mark IV loading, are separated and characterized by a mathematical model. The model is primarily based on power changes in the fuel and on expansion effects in the coolant, structure, and upper portion of the blanket. Experimental data were substituted into the model, and a set of time constants and power coefficients, which describe the feedback for given operating conditions, were obtained. (R.E.U.)

43022 (CVNA-211) MONTHLY OPERATING REPORT [ON CVTR OPERATIONS], JULY 1964. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). Contract AT(30-1)-2289. 32p.

The scheduled shutdown work begun the last week in June was completed early in July. The remainder of the month was utilized for reactor physics test work and power operation was intermittent as a result. The physics tests included: xenon tests, power coefficient test, flux wire tests, and dropped rod test. These tests were successfully completed. However, one part of the xenon transient test remains to be performed at a later date. At the end of the month, the reactor was shutdown to repair a leak on the main steam line. (auth)

43023 (CVNA-212) MONTHLY OPERATING REPORT [ON CVTR OPERATIONS], AUGUST 1964. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). Contract AT(30-1)-2289. 39p.

The reactor was operated at approximately full licensed power (44.3 Mw gross thermal). The generator was on the line for 707 hr and 16 min and the gross electrical generation was 6,830,000 kwh. The reactor was shutdown 25 hours to repair a helium leak. A revised heavy water inventory procedure was developed and programmed for computer analysis. Heavy and light water systems chemistry remained generally within specifications. Some slight degradation of heavy water was noted in the primary coolant system. The problem of significant fluoride concentrations in the moderator now appears to be due to peroxides interfering with the various methods of chemical analysis used. Radiation levels were observed to increase gradually above previous levels with additional reactor operation at power. However, the radiation dose incurred by plant personnel was very low. (auth)

43024 (DPW-64-135) HEAVY-WATER-MODERATED POWER REACTORS COOLED BY LIQUID D_2O OR H_2O. J. M. Boswell, W. G. Holmes, R. R. Hood, C. P. Ross, D. S. St. John, and J. W. Wade, comps. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Mar. 19, 1964. Contract AT(07-2)-1. 102p. (CONF-570-2)

From AEC Symposium on Advanced Converter Reactor Prototypes, Washington, D. C., Mar. 1964.

Heavy-water-moderated power reactors cooled by H_2O or D_2O in pressure tubes are discussed. Experimental investigations and facilities for a 1000-Mw(e) power plant are described. The use of H_2O as coolant in a D_2O-moderated reactor, and fuel cycles for D_2O-cooled power reactors are discussed. (R.E.U.)

43025 (EUR-1850.e(p.235-9)) INDUSTRIAL DEVELOPMENT OF POWER REACTORS IN THE EUROPEAN COMMUNITY. E. R. von Geldern (European Atomic Energy Community).

A general outline of the industrial activities undertaken by the EURATOM Commission within the Community is presented. The activities are directed toward raising the standard of living in community member states by stimulating establishment and growth of nuclear industries. (J.R.D.)

43026 (EUR-1850.e(p.141-51)) THE INDUSTRIAL DEVELOPMENT OF POWER REACTORS IN THE COMMUNITY. C. Ramadier and E. Parker (European Atomic Energy Community).

A review of nuclear power-plant development status in EURATOM member nations is presented. Comment is included on developments in Germany, Belgium, Italy, The Netherlands, and France. A discussion of EURATOM'S contribution to the industrial development of power reactors in the Community is also included. (J.R.D.)

43027 (EUR-1887.f) SITUATION ET PERSPECTIVES DE L'ÉNERGIE NUCLÉAIRE DANS LA COMMUNAUTE EUROPEENNÉ DE L'ÉNERGIE ATOMIQUE. (Situation and Prospects of Nuclear Energy in the European Atomic Energy Community). H. Michaelis (European Atomic Energy Community). 1964. 150p.

Nuclear energy is entering the industrial phase. Graphite-gas reactors and light-water reactors promise power production costs similar to those of conventional thermal plants fueled at 10 to 12 EMA u.a. per ton of coal equivalent. Since the prices obtained in practice for home-produced coal, imported coal and fuel-oil are higher, nuclear energy is competitive. This is true, at all events, for the large-capacity plants — of at least 400 Mw(e) — which are integrated in the base load. A discussion is given of the trends which are emerging for nuclear energy as a result of this situation. A forecast is made of the power which will be installed between now and 1980 in the Community — 40,000 Mw(e). The cost prospects for graphite-gas reactors, light-water reactors, so-called advanced reactors — particularly heavy-water reactors — and finally fast breeder reactors are indicated. The Community's supply problems in respect of natural uranium, enriched uranium, and plutonium are outlined. It is concluded that the development of nuclear energy is justified as a feature of energy policy by three imperative objectives, namely as cheap an energy supply as possible, as dependable an energy supply as possible, and optimum use of the world's limited energy resources. (auth)

43028 (GEAP-4623) EVESR — NUCLEAR SUPERHEAT FUEL DEVELOPMENT PROJECT. Eighth Quarterly Report, March–May 1964. J. L. Murray (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). June 1964. Contract AT(04-3)-189. 99p.

The EVESR low power testing program started on March 4. Power level was increased in increments as the reactor and plant tests were completed at each power level. Superheat steam was first produced on March 17 at a power level of 0.6 Mw. The reactor first attained full rated power of 12.5 Mw(t) on May 13. Operation at this power level was stable, and all auxiliary systems performed well. Full power steam flow through the reactor was 125,000 lb/hr, producing superheated steam temperatures of 732°F in the main header and 835°F in the divert header. Progress is also reported in design, fabrication, and development work. (J.R.D.)

43029 (IDO-28632) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. Quarterly Progress Report, April 1–June 30, 1964. (Aerojet-General Nucleonics, San Ramon, Calif.). Aug. 15, 1964. Contract AT(10-1)-880. 83p.

After pre-startup modification and checkout were completed in March, the ML-1 was taken to full power and operated above self-sustaining conditions for 664.5 hr, after which the plant was shut down for maintenance and inspection. The power plant performance deviated significantly from predictions in two areas: net work of the turbine-compressor (t-c) set was lower than anticipated, and read-out of the temperature of one instrumented fuel element was higher than anticipated. Disassembly and inspection of the t-c set (the CSN-1A) revealed that a spacer had slipped in the turbine, shearing the first stage turbine blades. Inspection of the instrumented fuel element revealed no cause for the above-prediction temperature reading. The fuel element was replaced in the core, and an additional instrumented fuel element was substituted for an uninstrumented fuel element in an adjacent core position. Operation of the seven-tube mockup of the ML-1 calandria in moderator water saturated with oxygen was terminated after 5501 hr. Fission gas release calculations for the IB-17R-2 experimental element showed that release from one pin was above predictions. Irradiation of the IB-17R-3 test element in the General Electric Test Reactor had accumulated 7043 hr by the end of June. The ML-1A preliminary design was completed and documented. Modification of the Gas-Cooled Reactor Experiment facility to permit testing of the ML-1 reactor skid without prototype power-conversion equipment continued. (auth)

43030 (NAA-SR-Memo-9856) HYDRAULIC STUDIES OF THE HNPF 8-ROD UC CORE II FUEL ELEMENT. J. H. Brindley (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 29, 1964. Contract [AT(11-1)-Gen-8]. 37p.

Hydraulic tests were performed in a water loop on a mockup of the HNPF Core II fuel element (a process tube containing an annular ring of eight fuel rods, wire spacers at one foot intervals, and a central support tube). Principles of dimensional similitude were used to convert the water test data to HNPF coolant conditions. The pressure drop across the fuel element at the design flow rate of 17.77 lb/sec of sodium was found to be 4.70 psi. With a spacer wire in the flow channel 6 inches and 18 inches upstream, the velocity-profile studies demonstrated that V_{max}/V_{avg} is 0.95 and 1.33 respectively, indicating that cross-flow exists in the bundle. (auth)

43031 (NP-14290(Pt.B)) TECHNICAL INFORMATION IN SUPPORT OF APPLICATION FOR CONSTRUCTION PERMIT AND LICENSE. MALIBU NUCLEAR PLANT UNIT NO. 1. (Los Angeles. Dept. of Water and Power and Stone and Webster Engineering Corp., [Boston]). Nov. 1963. 330p. (DOCKET-50-214)

A preliminary hazards summary for the Malibu Power Plant No. 1 is given. The pressurized-water reactor is scheduled for startup in 1967 and will operate at 1,473 Mw(t) with light water coolant and moderator. (R.E.U.)

43032 (NP-14319) PACIFIC GAS AND ELECTRIC COMPANY. FINAL HAZARDS SUMMARY REPORT, HUMBOLDT BAY POWER PLANT UNIT NO. 3. (Pacific Gas and Electric Co., San Francisco). Sept. 1, 1961. 496p. (DOCKET-50-133)

A description of the reactor and the operating procedures is presented. Safety features are evaluated. (R.E.U.)

43033 (PAN-505/IX-A) MEASUREMENT OF THE EPITHERMAL NEUTRON SPECTRUM INDEX IN WWRS REACTOR CORE. W. Kaczmarek and A. Szechter (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1964. 11p.

The epithermal neutron spectrum index was measured in VVR-S reactor core by the activation method using gold and indium foils. Absolute neutron density at a power of 300 w was evaluated. (auth)

43034 (TID-7050(p.1-14)) REACTOR PHYSICS AND ITS APPLICATION TO NUCLEAR POWER REACTORS. A. Radkowsky (Division of Reactor Development, AEC).

The reactor physics programs in the Naval Reactors and Shippingport programs are discussed. (R.E.U.)

43035 (TRG-Inf.Ser.-402) NUCLEAR POWER REACTOR ENGINEERING: SELECTED AND ANNOTATED REFERENCES. J. C. Hartas, comp. (United Kingdom Atomic Energy Authority. Reactor Group, Risley, Lancs, England). July 20, 1964. 13p.

A selection of 80 books in English for people wanting either an introduction to, or a list of standard works covering the general field of nuclear power reactor engineering is presented in annotated references. All are readily available, either commercially or through public and other large libraries. Arranged in 5 broad subject groups, the bibliography excludes operations not strictly the concern of the reactor engineer (e.g., fuel reprocessing, waste disposal, etc.) but includes references on metallurgy, fuel fabrication, corrosion, etc. A few major conferences have been issued in periodicals rather than in books, and these are included because of their importance. (auth)

43036 (TRG-Report-810) NON-LINEAR FAST FEEDBACK IN THE DOUNREAY FAST REACTOR. ITS MEASUREMENT AND AN EXPLANATION OF ITS ORIGIN. H. Atkinson, D. C. G. Smith, and D. Tait (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). July 2, 1964. 22p.

To estimate the kinetic behavior of the reactor under a wide range of conditions, including fault conditions, it is necessary to extrapolate the reactivity feedback to reactor powers beyond the normal range. Such extrapolation is simple if the feedback varies linearly with power. Early measurements on the *Dounreay Fast Reactor* showed that the temperature-induced reactivity feedback was negative, linear, and approximately as calculated. More recently the measurements showed that under certain conditions the fast acting feedback was reduced in amplitude and that its measured magnitude varied with the magnitude of the perturbation used in the measurement. An explanation for this non-linearity is proposed and discussed in detail. It is suggested that under certain conditions cumulative axial movement of the fuel occurs only after the fuel temperature has changed by more than a certain amount (about 5°C). Measurements with temperature perturbations less than this will not invoke cumulative axial expansion of the fuel. Once the perturbation exceeds the amount necessary to take up the initial "backlash," the reactivity feedback is once more linear with power, and extrapolation to higher powers is acceptable. The non-linearity will appear to some extent in the feedback of any fast reactor with segmented metal fuel, but it should cause no concern provided its effect on feedback measurements is appreciated. (auth)

43037 (UJV-1009/63) METODIKA OPTIMALISAČNÍHO VYPOČTU LAPLASIÁNU MŘÍŽE S TĚŽKOVODNÍM MODERÁTOREM, S PALIVEM UO_2(UC) A ORGANICKÝM CHLADÍVEM. (The Method of Optimalization Calculation of the LaPlacian of the Lattice With Heavy Water Moderator, With UO_2(UC) Fuel and Organic Coolant). B. Kujal and J. Kujal (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1962]. 41p.

Optimization calculations of the material parameter of the reactor type DOR with natural uranium in the form of UO_2 as fuel are presented. The calculation uses a single-group approximation and the assumption of a homogenized fuel cell. It assumes multiplication and absorption in the course of slowing down. The relations were arranged so that they were convenient for calculation on the Ferranti SIRIUS. This calculation is intended as an example of the calculation of heavy water lattices with ceramic fuel assemblies of uranium oxide or uranium carbide and cooled with an organic liquid. The aim of the calculation is to state the possibility of realization of this type of lattice and to determine the intervals of the quantities U_b, R, and β, within which the realization is possible. There is also included in the calculation a partial criterion for thermal performance. (TTT)

43038 (UJV-1029/64) ROZBOR VÝSLEDKŮ OPTIMALISAČNÍHO FYSIKÁLNÍHO VÝPOČTU REAKTORU DOR S KERAMICKÝM PALIVEM. (The Analysis of the Results of Optimalization Physical Calculation of the Reactor DOR With Ceramic Fuel). J. Kujal (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1960]. 69p.

The results of the optimization physical calculation, which was carried out for the lattice of DOR with uranium oxide and uranium monocarbide as fuel, are presented. There were enumerated about 600 cells with uranium oxide and 300 cells with monocarbide. The dependence of the material parameter on the radius and area of the cell, and the dependence of the specific cell volume filled with uranium (considering also the unequal utilization of the uranium in the cell) on the material parameter were determined. The calculations were carried out on the Ferranti SIRIUS at the Research Institute of Ferrous Metallurgy. The results of the calculations are presented in 56 graphs. (TTT)

43039 (WAPD-PWR-TE-161) SHIPPINGPORT PWR-1 SEED 4. FAST NEUTRON FLUX SPECTRUM IN THE SHIPPINGPORT NEUTRON SHIELD TANK. Test Evaluation. F. L. Lau, G. E. Pence, and G. G. Smith (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1963. Contract AT-11-1-GEN-14. 18p.

Portions of the fast-neutron spectrum in a nuclear instrument well were measured with a number of threshold detectors each sensitive to a different part of the spectrum. The weighted average of the neutron flux above 2.5 Mev at the sample location was obtained using a calculated spectrum from P3MG1 calculations. This flux value was compared with the neutron flux above 2.5 Mev as calculated by the P3MG shield design method. The calculated flux was greater than the weighted average value by 2 percent. Thus, it was concluded that reasonably accurate flux values at large distances outside of a reactor core can be obtained by this method of calculation. The sample location was approximately 80 cm from the core edge. (auth)

43040 VIEWPOINT FOR SAFER DESIGN OF THERMAL REACTORS WITH RESPECT TO REACTIVITY BEHAVIOR. At. Strom, 10: 53-4(July 1964). (In German)

Some important considerations in the evaluation of reactor safety in connection with the reactivity in the stationary and non-stationary state were discussed for thermal reactors. Definitions were given for reactivity, excess reactivity, shut-down reactivity, reactivity velocity, reactivity coefficient, and reactivity balance. (J.S.R.)

43041 THE AVR HIGH-TEMPERATURE REACTOR. Werner Cautius (Arbeitsgemeinschaft Versuchs-Reaktor (AVR) GmbH, Duesseldorf). At. Strom., 11: 33-38(May 1964). (In German)

A general review is given of the present state of construction of the AVR High-Temperature Reactor. The steam generator and fuel elements are described in detail. Costs and financing are discussed. (tr-auth)

43042 PREREQUISITES FOR THE UTILIZATION OF NUCLEAR ENERGY IN THE FEDERAL REPUBLIC OF GERMANY. H. Mandel (Rheinisch-Westfalisches Elektrizitatswerk AG, Essen). Atomwirtschaft, 9: 358-60 (Aug.-Sept. 1964). (In German)

The development and future outlook for peaceful uses of nuclear energy in the Federal Republic of Germany are discussed. Government support of nuclear research and contributions by the individual Federal states and by private industry are described. (M.C.G.)

43043 REACTOR DEVELOPMENT AND NUCLEAR POWER STATIONS IN GERMANY. H. Kuhne (Budesministerium fur Wissenschaftliche Forschung, Bad Godesberg, Ger.). Atomwirtschaft, 9: 365-74(Aug.-Sept. 1964). (In German)

The development of power reactors in the Federal Republic of Germany is described. Construction of the BBC-Krupp high-temperature reactor and the SSW heavy-water pressure-boiler reactor (MZFR) is discussed. A program being carried out for development of advanced reactors for experimental nuclear power stations having an electrical output between 10 and 30 Mw(e) is described. A nuclear research ship *Otto Hahn* is also described. A program for construction of medium- to large-capacity nuclear power plants is discussed. The various German nuclear plants are described. Work on breeder reactors is outlined. (M.C.G.)

43044 THE PROGRAM OF RESEARCH AND DEVELOPMENT OF THE VULCAIN REACTOR. P.-E. Maldague (BelgoNucleaire, Brussels) and R.-P. Kinsey. Belgicatom, Assoc. Belge Develop. Pacifique Energie At., Bull. Inform. No. 50, 21-7(June 1964). (In French)

The Vulcain reactor using heavy water and enriched uranium will be used in ship propulsion as well as power plants. The performance standards set for the reactor are given; and developmental efforts are outlined, including core studies, future testing of a core in the BR-3 reactor, design and development of the pressurization system, and studies of the pressurization system at low pressure. (D.C.W.)

43045 A RADIOLOGICAL HEALTH PROGRAM FOR AN EXPERIMENTAL POWER REACTOR. O. M. Derryberry (Tennessee Valley Authority, Chattanooga), O. W. Kochtitsky, and G. F. Stone. Health Phys., 10: 673-9 (Sept. 1964).

The program of preoperational and poststartup activities and responsibilities established by the Radiological Health Staff when TVA assumed the role of operating contractor for the EGCR is discussed. Features of the program include: development of radiation standards and review of plant design; training in radiation protection; emergency planning; planning for fixed and portable instrumentation; preoperational surveys; plant monitoring; guides for radioactive waste management and disposal; assistance in research and experimentation; and other health and safety activities. (H.M.G.)

43046 HOW ATOMIC POWER PRODUCTION GOT STARTED. Yelena Knorr. Kommunist Tadzh., 4(June 27, 1964).

Ten years ago, on June 27, 1954, the first atomic 5000-kw power plant began operating at the town of Obninsk. The reactor was the uranium-graphite thermal-neutron type with ordinary water cooling. The newly developed heat-generating units turned out to be sufficiently successful. They permitted a sufficiently high degree of burnup to 40 kg of nuclear fuel per ton, which considerably reduced the cost of electricity. The plant also turned out to be very convenient for further experiments; almost all of its 128 technological channels can be used for experiments. On April 26, 1964 the first 100,000 kw block of the Beloyarsk atomic electric power plant (AEPP) started operations with a very high efficiency. The basic peculiarity of this station is the direct super heating of the steam within the reactor. As is well known, the transition from water to super heated steam operation at the Beloyarska plant went without the slightest variation of the power of the reactor. The First Atomic Electrical Plant also carried out tests of stability of heat-generating materials. For example, at the Beloyarska plant steam is heated to 500°C, which corresponds to a 600°C temperature of the full element. At such a high temperature Xe and Kr gas can easily leave uranium, cause the swelling of elements, and damage the jacket. Under these conditions the heat-generating elements are required to operate through at least two years without letting out a single atom. In the future the main goal is to reduce the cost of the generated electricity. (OTS)

43047 THE SWISS REACTOR DEVELOPMENT PROGRAM. A. F. Fritzsche. Neue Tech., 6: 185-97(Aug. 1964).

The scope of the Swiss heavy-water reactor development program is surveyed. Comparative design studies were made on gas-cooled metallic uranium, gas-cooled uranium oxide, and steam-cooled uranium oxide concepts. Research on reactor physics, heat transfer and fluid flow, fuels, and fuel elements is described. Irradiation testing programs and technological development are discussed. (M.C.G.)

43048 INCREASE IN THE KNOWLEDGE OF GRAPHITE PERFORMANCE. K. Prince (United Kingdom Atomic Energy Authority, [Risley, Lancs, Eng.]), P. T. Nettley, and R. Lind. Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 2: 277-317.

The nature and effect of irradiation damage in graphite and the interaction of graphite with the products of radiolytic decomposition of CO_2 are discussed, together with the methods currently employed in the design of graphite moderated reactors to reduce the changes to acceptable levels. Other aspects of graphite behavior that are of interest in the context of graphite moderated, CO_2 cooled power reactors are also discussed. (P.C.H.)

43049 THE ADVANCED GAS-COOLED REACTOR. G. Brown (United Kingdom Atomic Energy Authority, [Harwell, Berks, Eng.]). Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963. 2: 355-78.

The design of the Windscale AGR is described, including fuel element assembly, moderator structure, and supporting experimental facilities. Safety considerations are discussed, and a data sheet for Windscale AGR and commercial AGR is included. (P.C.H.)

43050 EXPERIENCE IN OPERATING A POWER-PRODUCING FAST REACTOR. R. Hurst (Dounreay Experimental Reactor Establishment, Caithness, Scotland). Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 2: 379-95.

Experience in operating the Dounreay Fast Reactor is described. Coolant experience, control units, gas entrainment, criticality, physics, reactor shielding, and reactor fuel are discussed, along with future possiblities for the fast reactor. Core and breeder data are included. (P.C.H.)

43051 THE ROLE OF SAFETY IN THE PROGRESSIVE DEVELOPMENT OF POWER REACTORS. F. R. Farmer (United Kingdom Atomic Energy Authority, [Harwell, Berks, Eng.]), E. V. Gilby, and J. R. Beattie. Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 2: 397-412.

The range of serious accidents that is particularly relevant to reactor siting is discussed with consideration of how the various reactor systems have developed within the limitations imposed by these safety considerations. The discussion is confined to large power producing reactors and does not consider the special problems of research and test reactors. Gas-cooled reactors (uranium fuel, Magnox cans), AGR, fast reactor, and water reactors are included. (P.C.H.)

43052 NUCLEAR POWER, U.S.A. Walter H. Zinn (Combustion Engineering, Inc., New York); Frank K. Pittman (Division of Reactor Development, AEC); and John F. Hogerton (Little (Arthur D.) Inc., Cambridge, Mass.). New York, McGraw-Hill Book Co., 1964. 209p. $18.00.

A survey of U.S. progress in central-station nuclear electric power generation is presented. General discussions of saline water conversion, marine propulsion, and various specialized land and space applications of nuclear power are included. Technological progress related to power reactor development is reviewed. (R.E.U.)

43053 A SUPERHEATER NUCLEAR REACTOR. (to Licentia Patent-Verwaltungs GmbH). British Patent 970,118. Sept. 16, 1964. Priority date Feb. 12, 1960, Germany.

A superheating, boiling reactor is designed in which both functions of boiling and superheating are accomplished in passing through the fuel elements. In this reactor, narrow annular spaces in the fuel elements are used to produce and superheat the steam, and a dome is provided inside the pressure vessel and above the core for receiving the superheated steam. (D.L.C.)

43054 NUCLEAR FUEL ELEMENTS. (to United Kingdom Atomic Energy Authority). French Patent 1,278,416. Oct. 30, 1961. Priority date Jan. 21, 1960, Great Britain.

Calder Hall type fuel elements were designed, which present a thermally insulating disk between the fuel body and the adjacent end cap. In order to prevent lateral displacement of the disk, which can be composed of a number of thin plates or can have a stepped cross section, it was mounted in an interior cavity of the cap. (NPO)

43055 IMPROVED NUCLEAR FUEL ELEMENTS. (to United Kingdom Atomic Energy Authority). French Patent 1,278,417. Oct. 30, 1961. Priority date Jan. 21, 1960, Great Britain.

Calder Hall type fuel elements in which the end plugs are edge welded to the jacket are described. These welds are protected against damage by bell-shaped organs which contact the plugs and are fastened to the flank of the jacket. These are male and female cones. The resistance to traction of the jacket is greater than that of the cones or their joint with the jacket. (NPO)

43056 NUCLEAR CENTRAL STATION. (to Sulzer Frères Soc. An.). French Patent 1,321,767. Feb. 11, 1963. Priority date June 26, 1961, Switzerland.

Nuclear reactors are described in which the fuel elements are mounted in pressure tubes. In order to increase the mechanical resistance of the latter a thermal shield of moderating material, e.g. graphite, is interposed between the wall of the pressure tube and the fuel while a side stream of cold coolant is directed in the peripheral annulus thus formed. (NPO)

43057 PACKAGED NUCLEAR PLANT WITH INTEGRAL SUPERHEATER AND PRESSURIZER. J. H. Ammon (to U. S. Atomic Energy Commission). U. S. Patent 3,150,051. Sept. 22, 1964.

A nuclear fission reactor having integral steam generation apparatus including a superheater and pressurizer is described. The nuclear reactor is provided with naturally circulating primary water, which transfers the heat of fission from the core to the steam generation equipment located peripherally in the pressure vessel. External stabilizing drums are provided to separate the water from steam to the superheaters and also to act as a reservoir for steam in case of sudden load swings, such as evaporation of water to increase steam flow due to sudden drops in pressure in the steam line to the turbine or other points of steam use. (AEC)

Production Reactors

Refer to abstract 41923.

Propulsion and Space

43058 (EUR-586.d(App.)) DIE BAU- UND BETRIEBSKOSTEN EINER KERNENERGIE-ANTRIEBSANLAGE FUR HANDELSSCHIFFE IM VERGLEICH ZU DENEN HERKOMMLICHER HANDELSSCHIFFE UNTER VORAUSSETZUNG GLEICHER BENUTZUNG MIT DEM ZIEL GLEICHER WIRTSCHAFLICHKEIT. (The Construction and Operation Costs of a Nuclear Propulsion Installation for Trading Vessels in Comparison with Conventional Trading Vessels under the Assumption of Equal Use with the Goal of Equal Economy). K. Illies (Hanover. Technische Hochschule. Institut fur Schiffsmaschinen und Dampfkessel); and J. Legrand (Brussels. Universite). 1964. 109p.

Fuel-cost comparison charts are given for 60,000-, 80,000-, and 100,000-dwt tankers on the Venezuela route and the Persian Gulf route, for 20,000-, 40,000-, and 65,000-dwt freighters on the Magellan route and on the Panama Canal route, and for a fast freighter on the North American route and the Australian route for conventional (diesel) and nuclear power plants. The charts may be used to determine the economic feasibility of nuclear power plants. (J.S.R.)

43059 (EUR-1850.e(p.173-8)) DEVELOPMENT OF MARINE REACTORS IN THE EAEC. W. Rojahn (European Atomic Energy Community).

Work completed by the end of 1963 included design of a forced-circulation pressurized-water reactor (PWR), study of natural circulation PWR, feasibility of using direct-cycle and indirect boiling reactors, and comparison of various reactors by economic and technical standards. Research programs on reactor physics, shielding, and reactor materials are outlined. (J.R.D.)

43060 (NAA-SR-Memo-9750) TORQUE REACTIONS ON THE SNAP-2 REACTOR-REFLECTOR. PART I. D. Chin (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 31, 1964. Contract [AT(11-1)-Gen-8]. 13p.

Torque reactions on the SNAP 2 reactor-reflector assembly were computed for the firing of the M-130 squibs in the control drum actuator. The torque impulses being transmitted to the reactor-reflector assembly were computed for the dynamical input. Although the overall effect is that the torque impulses tend to integrate out to zero, nevertheless, the effect of each of the torque impulses at any given time may play a significant role in determining vehicle orientation and stability in free space. For two squib firings in one squib actuator, the resulting torque impulses about the vehicle c.g. were as follows: Nx = 1.35 in.-lb-sec, Ny = 18.0 in.-lb-sec, and Nz = 31.2 in.-lb-sec where Nx = the torque-impulse about the x-axis, Ny = the torque-impulse about the y-axis, and Nz = the torque-impulse about the z-axis. Depending upon the firing sequence of the squib actuators, the actual torque impulses will vary from zero (for all the actuators firing simultaneously) to a maximum of twice the above values. If two actuators fire simultaneously, some torque impulse components will add and others will cancel. (auth)

43061 (NAA-SR-Memo-9786) SNAP-10A DEVELOPMENT REACTOR MOCKUP. Test Program Summary. R. H. Prowett (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [Sept. 17, 1964]. Contract [AT(11-1)-Gen-8]. 18p.

Summaries are given of non-nuclear pre-flight tests of the SNAP-10A DRM. (R.E.U.)

43062 (NASA-CR-54111) SNAP-8 ELECTRICAL GENERATING SYSTEM DEVELOPMENT PROGRAM. Quarterly Report No. 0390-04-16. (Aerojet-General Corp., Azusa, Calif.). June 1964. Contract NAS-5-417. 248p.

The objective of the SNAP-8 Program is to design and develop a 35-kw electrical generating system for use in various space missions. Progress during the sixteenth quarter of contract performance is reported. The status of the various systems is discussed. Design and fabrication of components such as turbine alternator assembly, NaK and Hg pump-motor assemblies, bearing, seals-to-space, Hg boiler and condenser, Hg injection system, electrical insulation, and electrical components are reported. Testing the several component test loops is discussed. Materials evaluation of components exposed to Hg corrosion and erosion is presented. (auth)

43063 (ORNL-TM-716) BURNABLE POISON STUDIES FOR THE N.S. SAVANNAH REACTOR. T. D. Anderson, E. E. Gross, and M. L. Winton (Oak Ridge National Lab., Tenn.). Mar. 1964. Contract W-7405-eng-26. 37p.

Lifetime calculations were made for two families of Savannah cores characterized by either Zircaloy or stainless steel fuel-element containers. Within a given family of cores different core lifetimes were obtained by varying the enrichment. Control of the higher enrichment cores was effected by incorporating boron-10 in the stainless steel cladding to supplement the present control rods. Fuel-cycle cost analyses indicated that with either

Zircaloy or stainless steel fuel-element containers, there is a very definite economic incentive for increasing core life to as long as 4.5 full-power years (~6.75 calendar years). Relative to Core I fuel-cycle costs, the cost reductions as a result of increasing core life to 4.5 full-power years would be as much as 28% and 40% for the stainless steel and Zircaloy-container cores, respectively. (auth)

43064 (SC-RR-64-510) RE-ENTRY FLIGHT DEMONSTRATION NUMBER ONE (RFD-1): COMPARISON OF THE PREFLIGHT AND OBSERVED TRAJECTORIES. H. R. Spahr (Sandia Corp., Albuquerque, N. Mex.). Apr. 1964. Contract [AT(29-1)-789]. 59p.

The trajectory of the NASA Scout (S-116) launch vehicle successfully met the mission requirements for RFD-1. The radar data, optical data, and reported SARAH beacon signal, representing all the data available for defining the re-entry system trajectory, are presented. Good correlation between all the observed data and the theoretical postflight re-entry system trajectory is shown. However, because radar tracking was not obtained after r-f blackout, and because the optical data are available only down to about 80,000 feet altitude, no information for comparison with the postflight theoretical trajectory for altitudes below approximately 80,000 feet is available, other than the time and location of the brief reported SARAH beacon signal. (auth)

43065 (TID-7050) NAVAL REACTORS PHYSICS HANDBOOK. VOLUME I. SELECTED BASIC TECHNIQUES. A. Radkowsky, ed. (Division of Reactor Development, AEC). 1964. 1558p.

Separate abstracts were prepared for 42 selected topics in the basic theoretical and experimental aspects of light-water reactor systems, including both thermal and intermediate neutron-energy reactor types. The physics design of light water-moderated and -cooled reactors is covered in Volume II (issued in 1959 and classified), and that of intermediate neutron-energy power reactors in Volume III (issued in 1958). Volume I includes recent advances in reactor physics of the Naval and Shippingport Reactor Programs. (R.E.U.)

For abstracts of individual papers see: 42590, 42591, 42592, 42593, 42594, 42595, 42596, 42597, 42598, 42599, 42600, 42601, 42602, 42603, 42604, 42605, 42606, 42607, 42608, 42649, 42924, 42925, 42926, 42927, 42928, 42929, 42930, 42931, 42932, 42933, 42934, 42935, 42936, 42937, 42938, 42939, 42940, 42941, 42942, 42953, 42967, and 43034.

43066 EURATOM'S CONTRIBUTION TO THE DEVELOPMENT OF NUCLEAR PROPULSION FOR MERCHANT SHIPS. W. Rojahn (EURATOM). Belgicatom, Assoc. Belge Develop. Pacifique Energie At., Bull. Inform. No. 50, 7-9(June 1964).

The Dutch, German, and Italian efforts in nuclear propulsion development are briefly surveyed, together with joint work on shielding, mechanical strength tests, and anti-collision structures. (D.C.W.)

43067 STRUCTURAL AND OPERATIONAL SAFETY ASPECTS OF N.S. *SAVANNAH* IN RELATION WITH HER VISIT TO EUROPEAN PORTS. W. F. Vinck (EURATOM). Belgicatom, Assoc. Belge Develop. Pacifique Energie At., Bull. Inform. No. 50, 11-19(June 1964).

Some outstanding operational and structural features of the N.S. *Savannah* are outlined, based on safety evaluations covering structural details and the results of tests and sea trials. (D.C.W.)

43068 ON THE NORWEGIAN-SWEDISH SHIP REACTOR PROJECT, WITH SPECIAL ATTENTION TO THE OPERATIONAL PROBLEMS OF A NATURAL CIRCULATION B.W.R. AT SEA. Helge Christensen (Institutt for Atomenergi, Kjeller, Norway). Belgicatom, Assoc. Belge Develop. Pacifique Energie At., Bull. Inform. No. 50, 29-34 (June 1964).

An analysis of the dynamic behavior of a natural-circulation, boiling water reactor under accelerations typical of marine operation is summarized. Four system design changes were found to improve markedly the reactor response to gravitational disturbances. (D.C.W.)

43069 THE STATUS OF THE NETHERLANDS SHIP REACTOR DEVELOPMENT PROGRAM. M. Bogaardt and M. Muysken. Belgicatom, Assoc. Belge Develop. Pacifique Energie At., Bull. Inform. No. 50, 37-40(June 1964).

The main features of the pressurized-water reactor (NERO) are given; and studies of core physics (in critical and subcritical assemblies), poisoned fuel pellets, corrosion and erosion, hydraulics, heat extraction, the steam generator, and the pressurizer are outlined. (D.C.W.)

43070 INDUSTRIAL PROBLEMS. Charles Evrard. Belgicatom, Assoc. Belge Develop. Pacifique Energie At., Bull. Inform. No. 50, 53-7(June 1964). (In French)

The evolution of ship propulsion is briefly outlined, and the feasibility of nuclear propulsion for merchant vessels is indicated. The difficulties of nuclear propulsion are discussed from the viewpoint of the ship owner; including insurance, responsibilities, fuel costs and availability, and refueling. (D.C.W.)

43071 THE ITALIAN NAVAL PROGRAM FOR NUCLEAR PROPULSION. G. Cesoni, M. Vallauri, L. Chinaglia, G. Previti, and R. Fox. Belgicatom, Assoc. Belge Develop. Pacifique Energie At., Bull. Inform. No. 50, 71-4 (June 1964). (In French)

A comparative study of pressurized-water reactors with forced and natural circulation and of boiling-water reactors with direct and indirect cycles for ship propulsion is discussed, together with cost, weight, and safety considerations. (D.C.W.)

43072 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Stanley Hackney and Ronald Peter Williams (to United Kingdom Atomic Energy Authority). British Patent 969,814. Sept. 16, 1964. Filed July 5, 1962.

A reactor is designed which uses light water as both the pressurized primary coolant and the secondary coolant, and the heat transfer between the primary and secondary coolants takes place inside the reactor vessel. The pressure chamber for pressurizing the primary coolant is in the form of a coil of ducting shaped like a helical toroid. The reactor is advantageous for marine propulsion applications. Two embodiments of the reactor are described. (D.L.C.)

43073 COOLING INSTALLATION FOR NUCLEAR NAVAL REACTORS. (to Interatom Internationale Atomreaktorbau GmbH). French Patent 1,308,523. Sept. 24, 1962. Priority date Jan. 5, 1961, Germany.

The primary circuits of a naval reactor are enclosed in a safety container and provided with means for the removal of heat developed after reactor shutdown. Two heat exchangers are disposed within the container one at each side of the core. Both heat exchangers are normally under the level of the sea water. At least one of the heat exchangers remains at a higher level than the reactor core whatever the position of the ship will be. This ensures natural circulation of the coolant between the reactor and at least one of the heat exchangers so that the heat can be transferred to the sea water. A supplementary heat exchanger may be disposed under the reactor core. (IIB)

Research and Test Reactors

Refer also to abstracts 41107 and 41219.

43074 (AID-P-64-40) SOVIET FAST-PULSED RESEARCH REACTOR (IBR). Summary of Data. AID Work Assignment No. 31 (Report No. 12 in this Series). (Library of Congress. Air Information Div., Washington, D. C.). June 12, 1964. 16p. (AD-601316)

A description is given of the fast-pulsed research reactor (IBR) belonging to the Joint Institute of Nuclear Research, Dubna, and designed for physical investigations primarily for experiments utilizing time-of-flight techniques. (auth)

43075 (ANL-6821) A SUMMARY OF THE OPERATION OF THE ANL-2 PRESSURIZED WATER LOOP AT THE MTR. Final Report [of] Metallurgy Program. C. C. Crothers (Argonne National Lab., Ill.). May 1964. Contract W-31-109-eng-38. 30p.

A summary of the operation of the ANL-2 pressurized-water loop at the MTR for the period beginning January 1, 1954, and ending July 1, 1962, is given. Special attention is given to operational problems and to the modifications which were made to eliminate these problems. During the period of operation, twelve successful experimental tests were completed; each is described briefly. The operation of the loop was essentially continuous during the entire period. (auth)

43076 (CEA-R-2534) UTILISATION DE LA MAQUETTE DE PILE SILOETTE. (Use of the Model of the Pile SILOETTE). C. Meunier (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1964. 48p.

The nuclear model SILOETTE, which was temporarily installed at the rear of the swimming pool of the first reactor at the Grenoble Nuclear Research Centre (MELUSINE) and was then called MELUSINE II, has made it possible to choose and to study the first core design for SILOE during its construction. The essential results concerning the various designs tried for determining their minimum critical size, for calibrating the control rods, for comparing the different types of rod, and for measuring the thermal and fast fluxes are given. The rod calibration methods are discussed in order to show the advantages of the method applied to SILOE. The results obtained from MELUSINE II are compared with those obtained from SILOE itself. (auth)

43077 (EUR-1850.e(p.201-2)) EURATOM AND THE HIGH-FLUX REACTORS. P. Caprioglio (European Atomic Energy Community).

Efforts to operate high-flux reactors at the Petten Joint Research Center are reviewed. Other discussion is included concerning development of new irradiation devices and initiation of studies leading to substantial increases in reactor power. (J.R.D.)

43078 (EUR-1850.e(p.203-5)) THE CEN-EURATOM AGREEMENT FOR THE JOINT OPERATION OF THE BR-2 REACTOR. H. Ehringer (European Atomic Energy Community).

The design, operational aspects, and utilization of the BR-2 reactor are described. (J.R.D.)

43079 (KFKI-5/1963) ORGANIC IN-PILE-LOOP EXPERIMENT. Gy. I. Mathe, L. Retvari, G. Selley, T. Sass, and L. Bollok (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1963. 19p.

In order to study organic coolant moderators exposed to the mixed radiation and to the design temperatures and pressures of possible operating power reactors, an in-pile loop is designed, built, and loaded into the VVRS research reactor. Design problems, the experimental setup, and operating conditions of the in-pile loop as well as part of the measurements performed during the testing operation are described. (auth)

43080 (ORNL-TM-689(Rev.)) OPERATING SAFETY LIMITS FOR THE OAK RIDGE NATIONAL LABORATORY RESEARCH REACTOR (ORR). C. C. Webster (Oak Ridge National Lab., Tenn.). Sept. 1964. Contract W-7405-eng-26. 8p.

The operating safety limits designate the limits within which the reactor can be operated safely. The limits specified were determined by design or experience. The limits are listed according to the functional components. One section indicates what limitations are placed on experiments, and another section specifies the limitation placed on administration of the operation. (auth)

43081 (ORNL-TM-759) CRITICALITY FACTORS IN MSRE FUEL STORAGE AND DRAIN TANKS. J. R. Engel and B. E. Prince (Oak Ridge National Lab., Tenn.). Sept. 14, 1964. Contract W-7405-eng-26. 14p.

Calculations indicate that there is no danger in the fuel storage or drain tanks with fuel salt of normal concentration even if the salt is frozen and cooled to 20°C and the tank is submerged in water, provided the uranium remains evenly dispersed in the salt. If segregation of the uranium occurs during freezing and all the uranium accumulates in a region near the center of a tank, criticality will occur at 20°C for concentration factors of 4 or more. Criticality can be avoided by keeping the salt molten or by dividing the fuel charge among two or more tanks before it is allowed to freeze. (auth)

43082 (ORNL-TM-935) MSRE NEUTRON SOURCE REQUIREMENTS. J. R. Engel, P. N. Haubenreich, and B. E. Prince (Oak Ridge National Lab., Tenn.). Sept. 11, 1964. Contract W-7405-eng-26. 37p.

The alpha-n source inherent in the fuel salt meets all the safety requirements for a neutron source in the MSRE. Subcritical flux distributions were calculated to determine the combination of external source strength and detector sensitivity required for monitoring the reactivity. If more sensitive detectors than the servo-driven fission chambers are installed in the instrument shaft to monitor the filling operation, the calculations indicate that the required source strength can be reduced from 4×10^7 to 7×10^6 n/sec. An antimony–beryllium source with an initial strength of 4×10^8 n/sec would still produce 7×10^6 n/sec one year after installation. Because there is considerable uncertainty in the calculated fluxes, the final specification of source and type should be made after preliminary flux measurements have been made in the reactor. (auth)

43083 AREAS OF CONTROLLING CIRCUIT STABILITY IN A COLD REACTOR. Pavel Shtirskii (Scientific-Research Inst. of Power Engineering, Prague). At. Energ. (USSR), 17: 97-102(Aug. 1964). (In Russian)

An analysis is given of regions of circuit stability for the control of a zero-power reactor during regulator adjustment and of the average lifetime of prompt neutrons. It appears that the stability region is affected by a reactor-kinetics approximation by two equivalent groups of delayed neutrons. (tr-auth)

43084 RESEARCH REACTORS IN GERMANY AND THEIR USES. H. Weyand (Bundesministerium fur Wissenschaftliche Forschung, Bad Godesberg, Ger.). Atomwirtschaft, 9: 375-9(Aug.-Sept. 1964). (In German)

The 15 research reactors in operation and the 5 under construction in the Federal Republic of Germany are described. Uses of each of these reactors are discussed. (M.C.G.)

43085 REACTOR NOISE ANALYSIS OF SWIMMING POOL TYPE REACTOR. Shuji Yamada (Hitachi Ltd., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 1: 130-6(July 1964).

Reactor power frequency spectrum measurements at various power levels (0.2, 1, 5, 100, and 500 w, and 5 and 100 kw) were made with Hitachi Training Reactor (swimming-pool type). A low frequency a-c amplifier, a magnetic tape recorder, a frequency selective amplifier with twin-T filters, a multiplier, and an integrator were used. Speed-up and speed-down techniques of tape recorder were convenient for extending the frequency range of the analysis. The measured frequency spectrum of reactor noise determined the modulus of zero power transfer function, and indicated a prompt neutron mean life time of $(7.58 \pm 1.58) \times 10^{-5}$ sec based on an effective delayed neutron fraction of 0.0082. The calculations were made with a HIPAC-103 computer. At higher power, some resonance peaks were found in the low frequency region. The absolute value of reactor power obtained by noise analysis agreed within 3% with the power meter indication at the power below 5 kw. (auth)

43086 THE EXPERIMENTAL FACILITIES OF THE SWISS FEDERAL INSTITUTE FOR REACTOR RESEARCH. J. L. Meylan, H. Kuenzli, M. Stauffer, J. Brunner, H. Utzinger, G. Ullrich, and P. Baertschi. Neue Tech., 6: 170-9(Aug. 1964).

The engineering test reactor DIORIT, the swimming pool reactor SAPHIR, the subcritical assembly MINOR, the 100-kC hot laboratory at Würenbingen, and other research laboratories are described. (M.C.G.)

43087 EXPERIMENT OF BUBBLING VOID IMPORTANCE IN THE CORE OF JRR-2. Yasushi Nakai (Mitsubishi Atomic Power Industry, Inc., [Tokyo]), Kinichi Haginoya, Yasuhiko Miyasaka, Isao Arase, Shizuo Kikkawa, Denjiro Nemoto, and Osamu Sugimoto. Nippon Genshiryoku Gakkaishi, 6: 455-9(Aug. 1964). (In Japanese)

In order to understand the bubbling void importance, a series of experiments was undertaken in the core of the JRR-2. Bubbling voids were introduced as nitrogen or helium gas bubbles at various locations in the central experimental hole, fuel element, dummy fuel element, and upper reflector, and the relation between bubble flow rate, location of bubble generation, and reactivity change was investigated. It was very interesting to see that bubbling void importance is almost linear to the square of thermal neutron flux comparing the mass void, which has the flat importance distribution for the thermal neutron flux. In addition to these tests, checking the power fluctuation and reactor period owing to the bubble generation, less distinct change as reactivity change was recognized. All experiments were performed at room temperature. (P.C.H.)

43088 A BEAMHOLE FOR RADIOBIOLOGICAL STUDIES IN THE IRT-2000 REACTOR. Yu. I. Bregadze, I. V. Breiksh, D. Ya. Gubatova, R. Ya. Kemer, and A. A. Lapenas (Inst. of Physics and Biology, Academy of Sciences, Latavian, SSR and Inst. of Biology and Physics, Moscow). Radiobiologiya, 4: 627-31(1964). (In Russian)

In the design of the biological irradiation facility at the IRT-2000 reactor of the Institute of Physics of the Latvian Academy of Sciences, the experience acquired in the operation of Beamhole No. 1 of the IRT reactor of the Kurchatov Institute was made use of. The semiautomatic device installed in the facility greatly simplifies the insertion and removal of biological specimens, while ensuring safe and reliable operation. The power level may be varied within broad limits, allowing a great variety of biological irradiation experiments to be carried out. The minimum mixture of γ radiation amounts to 11% of the total dose. Passage of fast neutrons through the beamhole does not result in the distortion of the spectrum. Attenuation of the tissue dose in H-containing biological specimens shifts the fast neutron spectrum toward the high-energy side. For phantom measurements and as a monitor, a sphere made of S may be used at integral doses above 1.5 kr. (TTT)

43089 NUCLEAR REACTORS. (to American Machine and Foundry Co.). French Patent 1,308,213. Sept. 24, 1962. Priority date Dec. 23, 1960, United States.

In order to increase the power of a swimming-pool reactor the fuel elements are placed within a reflux pressure tube fed by a cooling circuit via common header chambers disposed one above the other at the bottom of the reactor. In this way the free accessibility of the core for the pool water, which is one of the advantages of the swimming-pool reactor, is maintained. The pressurized coolant within the tubes is separated from the pool water to prevent any fission-product contamination of the pool. The reflux tubes each consist of an outer cylindrical wall closed at the top and communicating at the bottom with the uppermost header. An inner cylinder coaxial to the outer one communicates at its top with the annular interstice between the cylinders and its bottom with the lowest header. The fuel elements have the form of several coaxially disposed cylindrical sheets. (IIB)

WASTE DISPOSAL AND PROCESSING

Refer also to abstract 41666.

43090 (IDO-14633) DRY COLLECTION AND DISPOSITION OF SOLIDS FROM FLUIDIZED-BED OFF-GAS. J. C. Petrie and D. E. Black (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 1964. Contract AT(10-1)-205. 27p.

Summarized operating experience is presented for cyclones used in the Waste Calcining Facility and in pilot plant calcination systems at the Idaho Chemical Processing Plant; results of test stand studies of parameters affecting cyclone collection efficiency are also given. Recommended operating conditions for cyclones handling abrasive and friable alumina particles are given. The present method of remote handling and disposition of radioactive material collected by the cyclone at the Waste Calcining Facility is described. Other methods considered for handling and disposition of cyclone fines are also discussed. (auth)

43091 (ORNL-TM-830) WASTE TREATMENT AND DISPOSAL QUARTERLY PROGRESS REPORT, NOVEMBER 1963–JANUARY 1964. R. E. Blanco and F. L. Parker (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 129p.

Development of a continuous-melting system for conversion of aqueous waste to glassy solids was continued. A "rising level" fixation test using simulated FTW-65 Purex waste was made. General operation was satisfactory. More than 99% of the mercury was removed from Purex FTW-65 waste solution by passing the solution through a column packed with copper. Gentle agitation of the column or imposition of a small anodic current on the copper increased the volume of waste that could be effectively treated from 76 to about 425 and 800 column volumes, respectively. Volatilization of cesium during calcination of sulfate-deficient Purex waste to 900°C was reduced by addition of aluminum. A program was initiated to define the compositional limits of desirable solid products from fixation of nonsulfate and of sulfate-bearing Purex wastes in phosphate media. Welded type 304L stainless steel exposed in boiling simulated Darex waste solution corroded less after coupling the steel to titanium. It was found that grundite clay is effective for sorbing cesium activity present in cation exchange regenerant waste. It also improved the decontamination factor for cobalt. In foam separation a method for direct, rapid radiochemical analyses by resolution of complex gamma spectra using the method of least squares was developed. Sludge-bed density values were determined to be an inverse function of both the feed flow rate and the sludge-blanket depth. Asphalt, tar, and cement were studied as media in which to disperse simulated waste-evaporator concentrates. Tritium management in wastes from fuel processing is being considered. For studies of disposal in deep wells, the relative behavior of tritiated water and chloride ions as water tracers was investigated. Construction of the injection plant was completed, and the waste pumps and injection pumps were operated to leak test the system. Gages for stress measurements in disposal in natural salt formations were tested. Diffusion coefficients based on a one-dimensional convective solution of the transport equation were obtained from the tracer tests run in the Clinch River. A special computer program was developed to analyze gamma spectra scans of the bottom-sediment cores. Strontium sorption by clay minerals, alumina, and Conasauga shale was studied. (M.C.G.)

43092 (UJV-973/63) ZPŮSOB DESAKTIVACE RADIOAKTIVNÍCH ODPADNÍCH VOD PROTIPROUDNOU SORPCÍ NA ZKOAGULOVANÉ SUSPENSI PŘÍRODNÍHO SORBENTU. (A Method of Deactivation of Radioactive Waste Waters by Countercurrent Adsorption of Coagulated Suspensions of Natural Adsorbents). Vladimír Veselý (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1963]. 106p.

Research work is described on the development of an original method of deactivating radioactive waste waters contaminated with artificial radioisotopes, principally ^{90}Sr and ^{137}Cs. For the deactivation, countercurrent contact of the contaminated waste water with a coagulated slurry of natural adsorbents is used. The most convenient natural material from a series of materials investigated proved to be the rhyodacitic tufa from Lower Hrabovce in Slovakia. This material also has the optimum sedimentation characteristic in the form of a suspended powder with particle size up to 0.1 mm. Investigation of the countercurrent adsorption showed that it is possible to apply the well-known laws of extraction to the system. The distribution coefficients for tracer cesium are quite high. For tracer strontium with a small calcium content a lower value is attained; however, the overall efficiency of separation in a three stage system will be at least one order higher than with the use of the classical single stage system. The efficiency of separation of tracer strontium is caused to increase by means of a preformed phosphate precipitate. A proposed technological scheme and some data for construction of a device with a capacity of 3.6 m^3 of waste water per hour are presented. (TTT)

43093 CEMENTATION OF HYDROXIDE DEPOSITIONS CONTAINING RADIOACTIVE ELEMENTS. Yu. M. Butt, V. V. Timashev, L. A. Kutsenko, I. E. Kozlova, and A. V. Gordievskii. At. Energ. (USSR), 17: 124-9(Aug. 1964). (In Russian)

The possibility is demonstrated of fixing the following radioactive materials in a cement stone: deposits consisting of hydrate of iron oxide, hydrate of aluminum oxide, hydrate of manganese oxide, sulfate-silica mass, and ashes of burned rags, paper, and wood. Conditions and operation modes for constructing cemented works utilizing the wastes are worked out. Costs of cement as a function of the waste content lies in the 20 to 50% range. Different isotopes are fixed in cement to different degrees: Nb and Ru better than Cs and Sr. (tr-auth)

43094 A STATION FOR PROCESSING AND CONDITIONING OF SOLID RADIOACTIVE WASTES. P. Cerré and E. Mestre (Commissariat a l'Energie Atomique, Paris). Health Phys., 10: 651-4(Sept. 1964). (In French)

Processing and conditioning of solid radioactive wastes have been resolved at the Saclay Nuclear Research Center. The processing and conditioning plant is divided in three zones: an inactive zone where the wastes are conditioned by incorporation in a concrete block in order to constitute a monolith. Every operation is automatically performed and, in this report, details are given on the successive operations of waste coating; a semi-active zone where the wastes of various nature and activity are received and through which they are introduced into the active zone; an active zone where the wastes are processed by compacting and shearing and then introduced into baskets constituting the concrete block core. Details are given on the various stages. (auth)

43095 THE SAFE BURIAL OF HIGH-LEVEL FISSION PRODUCT SOLUTIONS INCORPORATED INTO GLASS. W. F. Merritt and P. J. Parsons (Atomic Energy of Canada Ltd., Chalk River). Health Phys., 10: 655-64(Sept. 1964).

High-level waste-fission-product solution containing 1000 C was incorporated into glass blocks and the blocks buried for three years in sand beneath the water table. The experiment has shown that, even in saturated soil with low exchange capacity, the method of disposal was safe and the escape of hazardous radionuclides was within acceptably low limits. (auth)

43096 METHODS FOR THE TREATMENT OF ATOMIC WASTES. T. V. Arden and J. Pilot. J. Inst. Public Health Engrs., 62: 267-82(1963).

In a review of methods of treatment for low-activity atomic wastes, methods for the decontamination by coagulation and filtration and by ion-exchange resins are described. Both methods were inefficient in the removal of anionic activity. An experimental electrodialysis plant at Harwell is expected to produce an effluent containing 1 ppm or less of dissolved solids. (UKAEA)

43097 "FIXING" RADIOACTIVE WASTE IN GLASS. K. D. B. Johnson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). New Scientist, 23: 632-4(Sept. 10, 1964).

Experiments on the incorporation of radioactive waste in glass are reported. Radioactive waste in solution, and a slurry of glass-forming materials in water, flow into a vessel made of high alloy steel. The vessel is heated by a furnace at a temperature of 1050°C. Evaporation, conversion of nitrates to oxides, sintering of oxides and glass formation occur steadily during a period in which the vessel becomes filled with glass. The design of the pilot plant called FINGAL (Fixation In Glass of Active Liquor) is given. (P.C.H.)

43098 WASTE DISPOSAL. Reactor Fuel Process., 7: No. 3, 200-13(1964).

Development of equipment and methods of waste processing, including treatment of liquid wastes by evaporation and conversion of high-level-activity wastes to solids, is reviewed. The conversion of wastes to glasses is discussed along with pot, spray, fluid-bed, and rotary-ball calcination. (30 references). (N.W.R.)

43099 REMOVAL OF LOW-LEVEL RADIOISOTOPES FROM WASTE WATER BY AEROBIC METHODS OF TREATMENT. Charles Hillman Lawrence. Thesis, Gainesville, Fla., Univ. of Florida, 1963. 175p.

The removal of low-level radionuclides from waste water by a complete sewage treatment plant operating under field conditions was evaluated. A pilot-size treatment plant employing primary sedimentation, trickling filtration, and lagooning was utilized. These processes were subjected to a series of eight experiments involving phosphorus-32, iodine-131, potassium-42, cerium-141 and -144, iron-59, cobalt-58, strontium-89, and mixed fission products. The results indicated that primary sedimentation was relatively ineffective in removing colloidal and dissolved radionuclides from sewage. The effectiveness of the trickling filtration process was limited to the ability of the filter to remove the radioactive components from the main waste stream and to concentrate them in the solids leaving the filter in a settleable form. Consequently, the treatment efficiency of the over-all process was controlled by the removal accomplished by secondary sedimentation. Uptake studies indicated that the removal of low-level radionuclides within the filter resulted from the concentration of these materials by the zoogleal slimes present throughout the unit. Lagoon studies indicated that the long detention time and intimate algal-bacterial contact provided by this process were effective in diluting, delaying and, in most cases, substantially removing "slugs" of low-level radioactive materials. The basin had an effective detention time of two days and achieved the following removals: approximately 90 per cent for cerium-141 and -144 and iron-59; 69 per cent for strontium-89; 50 to 60 per cent for phosphorus-32, cobalt-58, and mixed fission products; and less than 1 per cent for iodine-131. The mechanisms indicated to be effective in the removal of radioactive materials by lagooning were precipitation by chemical, physical, and biological means and ion exchange reactions involving the suspended radionuclides and the stable materials retained in the basin. Trivalent materials in their colloidal form and divalent elements biologically significant in trace amounts were removed most effectively. (A.G.W.)

GENERAL AND MISCELLANEOUS

43100 (BNL-879) SOME ANCIENT GLASS SPECIMENS WITH COMPOSITIONS OF PARTICULAR ARCHAEOLOGICAL SIGNIFICANCE. Edward V. Sayre (Brookhaven National Lab., Upton, N. Y.). July 1964. Contract AT-30-2-GEN-16. 26p.

A program of chemical analysis was carried out on >400 specimens of ancient glass produced in Europe, Western Asia, and Northern Africa. The analyses of a few specific specimens which have archaeological significance are described. (D.L.C.)

43101 (BNL-7858) CRYOGENIC SAFETY AT BROOKHAVEN NATIONAL LABORATORY. L. A. Baker, Jr., C. Ferraro, Jr., and A. P. Schlafke, Jr. (Brookhaven National Lab., Upton, N. Y.). Feb. 25, 1964. Contract [AT(30-2)-Gen-16]. 24p. (CONF-678-1)

From 4th World Congress on the Prevention of Occupational Accidents and Diseases, London, July 1964. The Royal Society for the Prevention of Accidents.

Hazards of low-temperature processes and techniques are discussed. The hazards of liquid hydrogen used in high-energy physics research at Brookhaven are discussed in some detail. Bubble chamber hazards and ignition sources are considered. Research on liquid hydrogen hazards is reviewed. Other cryogenic fluids (helium and nitrogen) are considered briefly. (D.L.C.)

43102 (CONF-645-1) LARGE-DIAMETER SHAFT DRILLING WITH REVERSE CIRCULATION AIR, CASING AND CEMENTING FOR AEC EMPLACEMENT HOLES. Paper No. 851-38-H. T. B. Dellinger (Fenix & Scisson, Inc., Tulsa, Okla.) and C. K. Presley (Albuquerque Operations Office, AEC). [1963]. 9p.

From American Petroleum Institute Division of Production Spring Meeting of the Mid-Continent District, Hot Springs, Ark., May 1964.

The U. S. Atomic Energy Commission is drilling six foot diameter holes to below 4,000 feet with modified oilfield-type rotary drilling rigs with specially designed "big hole" drilling strings. Oilfield Drilling Contractors have been selected to perform the drilling operation. Low-pressure high-volume reverse circulated air is being used as the drilling medium. Loss of air to the formation is a problem as well as is the entry of water into the borehole. Casing and cementing problems are being exhaustively studied since final design features have not been completed to case the holes now being drilled. Rig, bit, tubular and equipment manufacturers and suppliers are working with the drilling contractors and the AEC to improve the drilling operation. Commercial drilling of large mine access and vent shafts is becoming more promising. (auth)

43103 (CONF-647-2) THE PREDICTION OF THE RISE OF A HOT CLOUD FROM FIELD EXPERIMENTS. Irving A. Singer, John A. Frizzola, and Maynard E. Smith (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 23p.

From Air Pollution Control Association 57th Annual Meeting, Houston, Tex., June 1964.

The rise of a hot cloud resulting from combustion of a solid propellant rocket fuel at ground level has been determined from lapse-time movies and visual aircraft observations. The field tests were conducted near the 420 foot meteorological tower under various atmospheric conditions. A method of predicting the maximum thermal rise of a cloud, based on source and meteorological parameters, is described. Comparisons with other theoretical formulations are presented. (auth)

43104 (D2-90224) BIBLIOGRAPHY OF REPORTS ON CRATERING, GROUND SHOCK, AND RELATED TOPICS. James P. Natland (Boeing Co., Seattle). July 13, 1962. 114p.

A total of 260 references, some of which are in abstracted form, is presented on cratering and ground shock. A report-source index is included. (D.L.C.)

43105 (EUR-1850.e) EURATOM SCIENTIFIC AND TECHNICAL ACTIVITIES. (European Atomic Community). 1964. 218p.

Separate abstracts were prepared for 21 sections of this report. One section describing the four EURATOM research establishments comprising the Joint Research Center was not abstracted. (J.R.D.)

For abstracts of individual sections see: 41009, 41673, 41674, 41675, 41882, 41883, 42791, 42877, 42878, 42879, 42880, 42964, 43025, 43026, 43059, 43077, 43078, 43106, 43107, 43108, and 43109.

43106 (EUR-1850.e(p.5-29)) THE CENTRAL BUREAU OF NUCLEAR MEASUREMENTS: EURATOM'S NUCLEAR BUREAU OF STANDARDS. J. Spaepen (European Atomic Energy Community).

A description of the Bureau is given. Kinds and fields of activity are described along with the equipment used. A review of past and present programs is included on neutron studies, isotope studies, and sample preparation methods. (J.R.D.)

43107 (EUR-1850.e(p.67-72)) EURATOM'S SCIENTIFIC ACTIVITIES. H. Kramers (European Atomic Energy Community).

A brief summary of EURATOM research results is presented. The origins of various research activities are reviewed, and programs associated with computers and information treatment, reactor physics, experimental neutron physics, experimental neutron physics, radiation effects on reactor materials and coolants, thermionic cells, and chemistry are discussed. Most of the research has been conducted at Ispra. (J.R.D.)

43108 (EUR-1850.e(p.153-62)) PRESENT POSITION AND TENDENCIES IN THE DEVELOPMENT OF NUCLEAR ENERGY IN THE EUROPEAN ATOMIC ENERGY COMMUNITY. H. Michaelis (European Atomic Energy Community).

Results of EURATOM investigations of the status and tendencies of Community nuclear industry development are presented. (J.R.D.)

43109 (EUR-1850.e(p.179-82)) EURATOM'S ACTIVITIES IN THE FIELD OF THIRD-PARTY LIABILITY AND INSURANCE AGAINST NUCLEAR RISKS. H. Tournès (European Atomic Energy Community).

Establishment in EURATOM of a system of third-party liability for damages caused by the operation of nuclear industries is discussed. Operators are obligated to provide themselves with insurance or other financial guarantees to meet their liability. Other aspects of the program, such as those associated with international law and compensation of claims out of public funds, are also discussed. (J.R.D.)

43110 (HW-67944) A REVIEW OF STUDIES IN SYNOPTIC CLIMATOLOGY, 1945–1958. C. L. Simpson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 4, 1961. Contract AT(45-1)-1350. 61p.

The basis for specification of atmospheric circulation patterns with polynomial equations is reviewed. Two methods of specification are demonstrated with numerical examples. A linear prediction equation with variables related to the circulation pattern is derived. A number of the more successful contributions of the applications of synoptic climatology are discussed in relation to the prediction of such elements as precipitation, temperature, sea-level pressure, and pressure change. (auth)

43111 (LADC-6179) TRANSDUCER STUDIES OF INITIATION PHENOMENA. J. R. Travis (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 5p. (CONF-683-3)

From 10th International Symposium on Combustion, Cambridge, Eng., Aug. 1964.

The shock polarization effect exhibited by a parallel-plate capacitor with explosive as dielectric and connected to an oscilloscope, has been used to study shock initiation of detonation in liquid explosives. Results are summarized briefly for nitromethane and TNT. (D.L.C.)

43112 (LADC-6180) MEASUREMENTS OF THE DETONATION FRONT STRUCTURE IN CONDENSED PHASE EXPLOSIVES. B. G. Craig (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 14p. (CONF-683-1)

From 10th International Symposium on Combustion, Cambridge, Eng., Aug. 1964.

Measurements of the detonation wave structure at the axis of long cylindrical charges of nitromethane and TNT are described. The measurements show that the structure consists of three zones: (1) a reaction zone, (2) an intermediate zone called the decay zone, and (3) a region of relatively slowly decreasing pressure. The decay zone, characterized by a rate of fall in pressure intermediate between those of the other two zones, is not predicted by any extrapolation of one-dimensional theory. In the liquid explosive nitromethane, the pressure at the head of the decay zone is essentially independent of the charge size, but the extent of the zone is very strongly dependent on the charge diameter and length. The decay zone increases in length as the detonation runs. In a 37 mm diameter charge, after a run of 16 diameters, the decay zone is about 0.6 mm long and the pressure falls about 27 kbar in the zone. In pressed TNT the decay zone behavior is very similar to that found in nitromethane. However, the pressure at the head of the decay zone is not constant but changes with the charge size, boostering, confinement, etc. This effect has undoubtedly led to large errors in the measurement of detonation pressures. (auth)

43113 (LADC-6181) ELECTRICAL MEASUREMENTS IN REACTION ZONES OF HIGH EXPLOSIVES. Bernard Hayes (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 24p. (CONF-683-2)

From 10th International Symposium on Combustion, Cambridge, Eng., Aug. 1964.

Electrical conductivity profiles with nanosecond and subnanosecond time resolution were determined for some condensed high explosives using a dynamic conductivity cell. Three explosives are treated in detail, namely, nitromethane, Composition B, and liquid TNT. Each explosive presents a somewhat different conductivity profile as well as a different value for the peak conductivity. The peak conductivity for nitromethane is about 160 mhos per meter, and the peak occurs between 1-½ and 2 nanoseconds behind the detonation front. The conductivity thereafter decreases to a nearly constant value of about 135 mhos per meter, falling off only slightly in the Taylor wave. The conductivity of Composition B, on the other hand, climbs steadily, reaching a peak value of 1100 mhos per meter between 80 and 100 nanoseconds after passage of the detonation front. Liquid TNT reaches peak conductivity about 20 nanoseconds after the passage of detonation front, even though the peak value of the conductivity is nearly an order of magnitude higher than that of Composition B. The profile experiments show that it is unlikely that a single value of the conductivity for detonation products is meaningful. However, the curves of conductivity as a function of time do have certain similarities in their shapes. If the conductivities at corresponding points on each curve, say the maximum, are compared, a strong correlation with the available estimates of the density of solid carbon in the detonation products is evident. This leads to the hypothesis that in carbon-rich explosives conduction is principally by a continuous network of solid carbon particles. (auth)

43114 (NP-14236) SECOND QUARTERLY STATUS LETTER, JANUARY 1–MARCH 31, 1964. (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Contract AF29(601)-6213. 140p.

The status is reported on analysis of ASTR radiation heating, analysis of radiation streaming in ducts, radiation transport studies, production and transport of inelastic gamma radiation, development and use of a consistent vibrations liquid model, irradiation of an IR detector assembly, thermal control coatings for space uses, radiation chemistry of polymers and normal saturated hydrocarbons, excitation of hydrocarbons by low-energy electron impact, induced-voltage studies, radiation effects in solid-film lubricants, radiation effects in elastomers and plastics in air, development of neutron-flux foils, development of solid-state gamma detectors, development of electronics for space uses, development of in-core-boiling detection system for GTR and ASTR, development of computer programs for hazards analysis, reactor operations support activities, rod-drive replacement in ASTR, instrumentation of tower for atmospheric physics measurements, and atmospheric diffusion studies in the NARF area. (J.R.D.)

43115 (NYO-2038-1) PRODUCTION AND STUDY OF ASPOROGENIC MUTANTS OF BACILLUS CEREUS. Annual Report, December 31, 1963–December 31, 1964. Donald G. Lundgren (Syracuse Univ., N. Y.). Contract AT(30-1)-2038. 75p.

The electron microscopy of cellular organelles, in particular polyribosomes and a membrane surrounding poly-beta-hydroxybutyrate granules, is discussed. These structures were seen in the C-1 mutant isolated and used in certain phases of the program. Relatively little polyribosome detail was seen in the wild type organism. A complex enzyme system obtained from extracts of Rhodospirillum rubrum hydrolyzes poly-B-hydroxybutyric acid (PHB) contained in native PHB granules isolated from Bacillus megaterium. A labile factor associated with the granules and necessary for depolymerization is easily destroyed by various chemical and physical treatments. Granules inactivated by these treatments were examined in the electron microscope. In all cases, the distinct morphological appearance of native granules was altered. Morphological changes were mainly characterized by membrane fragmentation, loss of coalescence, and surface alterations. These observations suggest that native PHB granules possess definite structural features, disruption of which results in decreased susceptibility of the polymer to enzymatic hydrolysis. PHB was characterized from different bacteria. All organisms had the same basic molecule but molecular weights varied depending upon the extraction procedure for obtaining polymer. The labeling patterns of chemical fractions of non-sporulating and sporulating cells of B. cereus and a mutant were followed after radioactive acetate was taken up by the cells. Acetate went into PHB and during sporulation some of the label went into CO_2, alcohol-alcohol-ether fraction and residual protein. Some enzyme assays are reported for normal and mutant cells during different stages of the vegetative cell-spore cycle. (auth)

43116 (ORNL-P-274) SIMILARITIES AND DIFFERENCES IN THE SPECIFIC IMMUNOLOGICAL UNRESPONSIVENESS BETWEEN GENETICALLY TOLERANT MICE AND THOSE MADE TOLERANT AT BIRTH. Joan Wright Goodman (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 8p. (CONF-703-1)

From 10th Congress of the International Society of Blood Transfusion, Stockholm, Sept. 1964.

In the course of a search for parental antigens not expressed in F_1 hybrid mice, observations were made on two kinds of unresponsiveness: genetic, or that of a hybrid toward its parents, and induced or actively acquired, exemplified by a parental strain made tolerant to a second parental strain by receiving F_1 hybrid cells at birth. Both groups of mice failed to produce circulating hemagglutinins to second parental cells, and this failure was specific. Mice from both groups underwent wasting disease when given an injection as adults of second parental spleen cells. Histologically, lymphatic tissues of tolerant parental mice appeared less severely atrophic than those of genetically tolerant F_1's. Their marrow was regularly more cellular than that of hybrids similarly treated. A theoretical possibility, involving the breaking of tolerance in parental mice, is offered to explain the observed differences seen between two groups that might have been expected to behave similarly. (auth)

43117 (PNE-211F) CLOSE-IN AIR BLAST FROM A NUCLEAR EVENT IN NTS DESERT ALLUVIUM. L. J. Vortman (Sandia Corp., Albuquerque, N. Mex.). [nd]. Project SEDAN. Contract [AT(29-1)-789]. 48p.

Close-in air blast from the Sedan event was considerably greater than expected on the basis of previous measurements of blast from nuclear events in basalt and from HE events in both basalt and alluvium. In spite of overranging of the pressure gages, the measurements permit derivation of a lower limit of peak overpressure and on upper limit on the amount of blast suppression resulting from charge burial. Comparison of Sedan blast suppression with that of previous buried HE and nuclear shots shows that Sedan blast suppression was considerably less than would have been predicted from HE shots at comparable burst depths. Sedan peak overpressures were two to three times those of Stagecoach III at approximately the same cube-root sealed burial depth and four times those of Scooter or Buckboard 12 (at or near the burial depth for maximum crater). The scaled total positive-phase impulse for Sedan was about the same as those of Stagecoach III, Buckboard 12, and Scooter, while the scaled positive-phase duration was much shorter. Blast suppression factors, based on peak overpressure and impulse, reflect the above differences. The differences may be due, in part at least, to a higher pressure in a relatively smaller cavity volume at the time of venting for Sedan than for the HE shots. (auth)

43118 (RM63TMP-26) PROPERTIES OF BALLISTIC FIREBALL RISE. Gerhard Rohringer (General Electric Co. Technical Military Planning Operation, Santa Barbara, Calif.). July 1, 1963. Contract DA 49-146-XZ-038. 35p. (DASA-1410; AD-436470).

The processes leading to ballistic rise are analyzed. Formulas for the computation of ballistic rise speeds are given. Expansion during ballistic rise is discussed qualitatively. The settling of neutral debris is computed in detail. (auth)

43119 (SC-R-64-137) FABRICATION OF PROTOTYPE CIRCUIT BOARDS—FROM PRODUCTION DRAWINGS TO COMPLETED BOARDS IN A FEW HOURS. D. R. Lewis (Sandia Corp., Albuquerque, N. Mex.). May 1964. Contract AT(29-1)-789. 17p. (CONF-515-1)

From 2nd Annual National Electronics Packaging and Production Conference, New York, June 1964.

A proven method is described for making small quantities of prototype circuit boards in an extremely short time, particularly when compared to the time required using the chemical etching process. By the method discussed, a printed circuit board drawing is converted to an electrically adequate circuit board in a matter of hours by cutting circuit isolation grooves into copper-clad epoxy glass laminate with a pantograph milling machine. A step-by-step description of the process is given, and process capabilities, limitations, and fabrication time estimates are also discussed. (auth)

43120 (SC-TM-64-590) QUALITY OF SPARE PARTS. D. L. Field (Sandia Lab., Albuquerque, N. Mex.). Apr. 1964. Contract AT(29-1)-789. 22p.

Spare parts quality has become one of the major problems of the Department of Defense. Some aspects of the problems involved in substandard quality of spare parts are discussed, and a method for evaluating and improving quality programs to minimize these problems is presented. (auth)

43121 (SC-TM-64-669) PHANTOM GAGE DIMENSIONING. COMBINED PART/GAGE SPECIFICATIONS. E. S. Roth (Sandia Lab., Albuquerque, N. Mex.). July 1964. Contract [AT(29-1)-789]. 19p.

A discussion is given of a new design definition technique, requiring no standard, which pictorially shows part and gage limits on the same drawing. When functional gages, test fixtures, or optical chart gages are the selected inspection method, design, manufacturing process, and gage engineers can use these drawings directly to replace the usual standards-based drawings. In essence, this advanced technology visually describes true position dimensioning and tolerancing. It enables product designers to directly control the acceptance process. (auth)

43122 (SCL-DR-64-64) A METHOD FOR COMPUTER CALCULATION OF SHEAR AND MOMENT SPRING CONSTANTS FOR LATERAL DYNAMIC AXISYMMETRIC MODELS. L. H. Bakken (Sandia Corp. Livermore Lab., Livermore, Calif.). Sept. 1964. Contract [AT(29-1)-789]. 39p.

The analysis of the lateral dynamic response of axially symmetric shell structures has required the calculation of spring constants by a tedious superposition of the stiffnesses of concentric structural material layers. The mechanization of these calculations by taking advantage of a numerical description of the geometry used for weight and center of gravity studies is described. The shears and moments due to unit translations and rotations between the nodes of a lumped mass model are calculated by the moment-area stiffness of the geometry of the continuous structure. This operation was programmed for the digital computer. An example beam problem showing input and output is included. (auth)

43123 (SCR-663) TRANSIENTS IN WIDE-ANGLE CONICAL ANTENNAS. C. W. Harrison, Jr., and C. S. Williams, Jr. (Sandia Corp., Albuquerque, N. Mex.). June 1963. 64p.

Sandia Corp. Monograph.

The response of an antenna to d-c pulse excitation, both in reception and in transmission, can be determined by use of Fourier transforms provided the impedance and effective height of the antenna are known over the frequency range where the excitation has significant components. The time history of the response of a wide-angle conical antenna to d-c pulse excitation was computed and the results are shown for a matched source in transmission and a matched load in reception for several values of cone angle and antenna length. Under matched conditions, the faithful transmission of a pulse shape requires a long antenna while faithful reception is not possible. Faithful reception can be achieved by a short antenna with a resistive load of high resistance or with a capacitive load, or by a long antenna with a series RC load. Since the work required impedance and effective height of conical antennas over a wide frequency range, graphs of these quantities for a number of cone angles are also given. (auth)

43124 (TID-5059(6th Rev.)) CORPORATE AUTHOR ENTRIES USED BY THE DIVISION OF TECHNICAL INFORMATION IN CATALOGING REPORTS. Clara L. Fox, ed. (Division of Technical Information Extension, AEC). Mar. 1964. 148p.

A list is given of the corporate author entries used to designate institutions, societies, industrial organizations, governments, etc. which issue reports. Cross references are used extensively to aid in the search for desired entries. Rules for developing corporate author entries are given. (D.L.C.)

43125 (TID-7700) TENTH ANNUAL AEC-CONTRACTOR NUCLEAR MATERIALS MANAGEMENT MEETING, GATLINBURG, TENNESSEE, OCTOBER 19-21, 1964. (Oak Ridge Operations Office, AEC and Oak Ridge Gaseous Diffusion Plant, Tenn.). Contract W-7405-eng-26.

Fourteen papers are presented on related topics such as fuel subcontracts, inventory management, nuclear safety, data processing, etc. Separate abstracts were prepared for eleven of the papers. For abstracts of the other three papers, see NSA 18: 25270, 33799, and 40211. (D.L.C.)

For abstracts of individual papers see: 41681, 41682, 41932, 43126, 43127, 43128, 43129, 43130, 43131, 43132, and 43133.

43126 (TID-7700(p.1-7)) RELATIONSHIP OF NUCLEAR MATERIALS MANAGEMENT TO THE FUEL SUBCONTRACT DOCUMENT. Fred H. Tingey (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

Financial responsibility clauses, which were added over the past few years to subcontracts for fuel element fabrication, are described. These provisions treat material imbalance, degradation of uranium, and delivery of scrap. The standard nuclear material article prepared by AEC is also included in the subcontracts. The retention provision and penalties are discussed. (D.L.C.)

43127 (TID-7700(p.8-29)) MATHEMATICAL APPROACHES TO INVENTORY MANAGEMENT. A SURVEY. James E. Lovett (Division of Nuclear Materials Management, AEC).

The literature of operations research for inventory and production control is surveyed from the standpoint of its applicability to management of nuclear materials. No attempt is made to suggest particular models for particular applications; rather, a discussion is given of the nature and quality of input data needed, the effect of various assumptions on the mathematical complexity and practical applicability of the model, and the philosophical role of mathematical analysis in the decision process. (auth)

43128 (TID-7700(p.30-40)) TECHNIQUES TO OPTIMIZE NUCLEAR MATERIAL INVENTORIES FOR RESEARCH AND DEVELOPMENT. H. F. Stringfield (Oak Ridge National Lab., Tenn.).

The implementation of the AEC "Commercial Processing and Fabrication" procedures has resulted in a major portion of ORNL nuclear material component requirements being procured commercially under subcontract arrangements. Internal procedures followed in forecasting, scheduling, and procurement are presented in connection with managerial responsibility. Also included are consideration of recovery or discard of scrap and utilization of spare products and components. (auth)

43129 (TID-7700(p.72-84)) UTILIZATION OF A MEDIUM-SIZE COMPUTER IN A CENTRALIZED FACILITY. A. H. Wernecke (Goodyear Atomic Corp., Piketon, Ohio).

Upgrading of an IBM-650 computer for use in the solution of scientific problems to an IBM-1410 computer with combined use for business as well as scientific application has resulted in significant savings. Early planning, reorganization of functions, establishment of committees, and experiences to date are related. (auth)

43130 (TID-7700(p.85-97)) COMPUTER PROCESSING OF URANIUM MANUFACTURING AND SHIPPING DATA. G. L. Hammons (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Computer programs have been developed at Hanford which (1) generate uranium fuel core Lotting and Receiving Reports, and (2) allow a complete analysis of all feedsite data related to the production and inspection of these cores. The Receiving Reports are generated on a daily basis for the purpose of material accountability and lotting, while the Data Summary and Retrieval Program is used for weekly or monthly analysis of the feedsite manufacturing process and other engineering problems. Combination of the two programs results in a system in which the raw processing and inspection data for each shipment are used to generate a Receiving Report which (1) lots all incoming material, (2) lists and summarizes feedsite generated data, (3) detects any out-of-specification cores, and (4) calculates factor weights for nuclear material accountability. All of the above systems are programmed for the IBM 7090 computer. (auth)

43131 (TID-7700(p.98-109)) RANDOM ACCESS EDP FOR MATERIAL ACCOUNTABILITY. Charles R. Lepper (Mallinckrodt Chemical Works, St. Louis).

Randon-access electronic data processing (EDP) equipment is used to process and store data and to provide for production reporting, analytical certifications, and nuclear materials accountability. (D.L.C.)

43132 (TID-7700(p.110-19)) SOURCE AND SPECIAL NUCLEAR MATERIALS CONTROL UTILIZING ELECTRONIC DATA PROCESSING. A. P. Bass (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.).

The operations of the Y-12 plant are described briefly, and its SS materials accountability program is discussed in some detail. The SS control philosophy in the plant is summarized, and the technique of reducing the monthly unaccounted-for amounts in each balance area is illustrated using a machine shop in the Y-12 plant. (D.L.C.)

43133 (TID-7700(p.145-60)) EVALUATION OF A NEW FALLING-STREAM SAMPLING SYSTEM TO BE USED AS A REFERENCE AT WELDON SPRING. W. A. Ziegler and S. H. Huston ([Mallinckrodt Chemical Works, St. Louis]).

A new falling-stream sampling system was designed for use as a primary reference in the sampling of uranium concentrates for payment purposes. The advantage of the system is that its internal operation can be visually monitored without exposing the concentrate to the atmosphere. A secondary sample splitter was used to evaluate this reference system, and agreement between the two samplers was excellent. (D.L.C.)

43134 (TID-21006) MINERAL CONTENT OF NATIVE PLANTS OF WISCONSIN. Research Report No. 14. G. C. Gerloff, D. D. Moore, and J. T. Curtis (Wisconsin. Agricultural Experiment Station, Madison). May 1964. Contract [At(11-1)-788]. 27p.

Plant tissue samples were collected from 14 plant communities with a minimum of 10 samples collected from each location. The tissues of each plant were analyzed for mineral content. Analytical procedures are described. Data are presented on the content of N, P, S, Ca, Mg, K, Fe, Mn, Cu, Zn, Mo, B, Cl, and Sr in some 300 plant species found in Wisconsin. (C.H.)

43135 (TID-21143) OPTIMUM CONDITIONS FOR HEAT-TREATED STEELS (thesis). Huai-Pu Chu (Colorado School of Mines, Golden). [196?]. Contract AT(11-1)-1173. 73p.

An experimental method of determining optimum carbon content for steels has been developed by using notch tensile test specimens. To avoid brittle fracture, this optimum, which was found to be about 0.40% carbon, should be used in structural applications requiring very high strength in the presence of sharp notches. For a given carbon content, the optimum hardness was also determined as a function of specimen size. Larger specimens have a lower optimum hardness than small specimens, and vice versa. The optimum hardness occurs at the boundary between the ductile and brittle regions. (auth)

43136 (TID-21155) EFFECTS OF H^{3}THYMIDINE AS A DNA LABEL IN THE RAT LIVER. Joseph Post (New York Univ., New York. School of Medicine and Goldwater Memorial Hospital, New York). [1964]. Contract AT(30-1)-2778. 6p.

Results are reported from studies on the effects of various tracer doses of ^{3}H-thymidine on replication times and patterns of cells in the liver of young rats. Doses of 10 μc/gm caused changes in DNA synthesis and in replication similar to those induced by x and γ radiation. It was concluded that metabolic activities involved in cell division are more radiosensitive than those activities involved in cell survival. Preliminary results are reported from a long-term investigation of cell proliferation patterns and ploidy in replicating populations of liver cells of rats of different ages and with different types of autogenous tumors. Studies on the kinetics of tumor cell replication in vivo indicated that tumor cell replication is orderly, is under control, and is similar in many ways to that of normal cell lines. (C.H.)

43137 (UCRL-10981) THE POTENTIALITY OF AUSFORM STEELS FOR PRESTRESSING. V. F. Zackay and W. W. Gerberich (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1963. Contract W-7405-eng-48. 28p. (CONF-700-1)

From Prestressed Concrete Symposium, San Francisco, Oct. 1963.

Conventionally quenched and tempered martensitic steels are generally limited to structural applications which require yield strengths of 300,000 psi or lower. Steels having yield strengths greater than this are characterized by poor ductility and toughness. A new process designed to extend the limits of usefulness of these steels is described. By a thermal-mechanical treatment, ductile martensitic steels having yield strengths between 300,000 and 400,000 psi can be obtained. The processing variables of alloy composition, deformation, and deformation temperature are discussed. The response of several proprietary alloys to this thermal-mechanical treatment is shown. Unusual room and elevated temperature properties, including strength and fatigue resistance are described. Some of the factors pertinent to the potential use of Ausform steels for prestressing are considered. (auth)

43138 (WIS-TCI-63G) FOCUSING OF SYMMETRIC TOP MOLECULES WITH THE ELECTRIC SIX-POLE FIELD. K. H. Kramer and R. B. Bernstein (Wisconsin. Univ., Madison. Theoretical Chemistry Inst.). Sept. 1, 1964. Contract AT(11-1)-1328. 21p. (COO-1328-10; CR-15)

The electric six-pole field is applied to the focusing of beams of symmetric top molecules via the first order Stark effect. Molecules capable of a specified degree of orientation can be selected according to the voltage applied to the electrodes of the six-pole field. The molecules CH_3I and CHI_3 were chosen to illustrate the focusing action for prolate and oblate symmetric tops. (auth)

43139 (WIS-TCI-65G) INTERNAL ENERGY OF REACTION PRODUCTS BY VELOCITY ANALYSIS. I. SCATTERED KBr* FROM THE CROSSED MOLECULAR BEAM REACTION K + HBr. Arthur E. Grosser, Anthony R. Blythe, and Richard B. Bernstein (Wisconsin. Univ., Madison. Theoretical Chemistry Inst.). Sept. 9, 1964. Contract AT(11-1)-1328. 24p. (COO-1328-11)

The velocity distribution of excited KBr* formed in reactive collision between crossed beams of velocity-selected K and thermal HBr was measured as a function of scattering angle for two different initial relative kinetic energies, E. The most probable value of the recoil velocity of the KBr* yields the final relative kinetic energy E′ and thus the value of the most probable "collision-exothermicity" $Q \equiv E' - E = \Delta D_0^0 - \Delta E_{\mathrm{int}}$, where ΔE_{int} is the most probable value of the internal energy change. Results of a series of experiments at $E = 1.9$ kcal/mole gave $Q = 0.5 \pm 0.5$ kcal/mole (out of an a priori range from -1.9 to $+5.1$ kcal/mole) and thus the most probable internal (excitation) energy for the KBr: $E^*_{KBr} = 4.6 \pm 0.7$ kcal/mole. The observed angular and velocity distributions of KBr imply that the differential reactive scattering cross section in the center-of-mass (c.m.) system is predominantly confined to low angles (i.e., "forward hemisphere," with the KBr* product preferring the direction of the incident K in the c.m.). Less extensive experiments at $E = 3.2$ kcal/mole served to confirm these conclusions. (auth)

43140 (FTD-TT-64-892) COSMIC RESEARCH. Translation of Kosmicheskie Issledovaniya, 2: No. 4, 507-654(1964). 246p.

Separate abstracts were prepared for 3 of the 15 papers included; one was previously abstracted for NSA (18: 17864). The remaining papers include space vehicle flight and reentry, magnetic storms, properties of the atmosphere, burning of plastics in plasma flows, and coatings for silicon photocells. (R.E.U.)

For abstracts of individual papers see: 41095, 41243, and 42331.

43141 (JPRS-26310) TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 108. Translated from K'o Hsueh T'ung Pao, No. 6, 518-21; 529-34; 535-41(June 1964). 48p. (TT-64-41569)

Eight selected articles are presented on the following topics: oxygen transportation from stalk and leaves to roots in plants, mechanism of decline of seed lifespan, reduction of U from low-grade U ore with Al foil, chemistry of 1-benzyl-4-methyl-3,4-cyclotetramethylpyrazolone-5 in polymerization of phosphoric acid, Diophantine approximations in numerical integration, and complex ion equilibria in solutions. A separate abstract was prepared for the article on the reduction of U from ores. (D.L.C.)

43142 COMMENTS ON "SPUTTERING IN THE UPPER ATMOSPHERE." R. V. Stuart (Litton Industries, Minneapolis). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 1678 (Sept. 1964).

Weight losses from a gold surface orbiting at 200 km were previously attributed to sputtering by N_2, the impact energy being 9 ev. Out-gassing is proposed as a more likely mechanism for the weight loss, and an error in the original calculation of the sputtering yield is noted. (D.C.W.)

43143 ORGANIZATION OF ATOMIC ENERGY IN GERMANY. W. Cartellieri (Bundesministerium fur Wissenschaftliche Forschung, Bad Godesberg, Ger.). Atomwirtschaft, 9: 362-4(Aug.-Sept. 1964). (In German)

The organization of governmental atomic energy authorities in Germany, with the distribution of competences between federal and state governments, is described. Expenditures incurred during the period 1956 to 1963 by federal and state governments towards the promotion of nuclear research and the advancement of nuclear engineering are surveyed. (M.C.G.)

43144 THE GERMAN NUCLEAR INDUSTRY AT THE ACHEMA 1964. Atomwirtschaft, 9: 411-32(Aug.-Sept. 1964). (In German)

Participation by the German industry in the 1964 ACHEMA, congress and exhibition of the chemical engineering industry, is discussed. Exhibits displayed by German nuclear firms are described and some pictures are shown. Exhibits by foreign manufacturers are also described. (M.C.G.)

43145 THE HISTORY AND THE PRESENT ORGANIZATION OF THE SWISS EFFORTS IN THE FIELD OF ATOMIC ENERGY. U. Hochstrasser. Neue Tech., 6: 165-70(Aug. 1964).

The historical development of Swiss efforts in the field of atomic energy is reviewed. The organization of basic research, reactor development, uranium prospecting, and Swiss participation in international cooperation in the atomic energy field is described. The roles of the government and Swiss societies in this field are considered. Expenditures of the Swiss in atomic energy and the outlook for the future are discussed. (M.C.G.)

43146 EURATOM 1964. SEVENTH GENERAL REPORT ON THE ACTIVITIES OF THE COMMUNITY (MARCH 1963–FEBRUARY 1964). 110p. DOCUMENTATION ATTACHED TO SEVENTH GENERAL REPORT ON THE ACTIVITIES OF THE COMMUNITY (MARCH 1963–FEBRUARY 1964). 211p. (European Atomic Energy Community). Mar. 1964. FB 150,-; Ffr. 15,-; DM 12,-; Lit. 1.870-; Fl. 11,-.

A survey of Euratom's activities is included, dealing in turn with the energy situation, the broad outline of the research program, and then discussing the organization's work in sponsoring the industrial use of nuclear energy, health protection and biology, ways and means of achieving Euratom's various objectives and, finally, external relations. The second volume contains detailed explanations of the various subjects discussed in the first section. An alphabetical index is given at the end of the first volume for reference purposes. (P.C.H.)

43147 RESEARCH, U.S.A.—KNOWLEDGE FOR THE FUTURE. Albert V. Crewe and Joseph J. Katz (Argonne National Lab., Ill.). New York, McGraw-Hill Book Co., 1964. 225p. $18.00.

Basic research subsequent to 1958 on elementary particles, neutrons, nuclei, a new periodic table, ionizing radiations and matter, radiation and life, isotopes in research, and fusion research in the United States is reviewed. (R.E.U.)

43148 ANIMAL WATERING NIPPLE AND BOTTLE CAP COMBINATION. James W. Harrison (to U. S. Atomic Energy Commission). U. S. Patent 3,149,611. Sept. 22, 1964.

An animal watering device was developed for use in laboratories handling large numbers of small animals such as mice, hamsters, etc. A reusable stainless steel nipple is inserted into a central hole in a plastic bottle cap. A flange on the nipple is supported by the rim of the capped bottle. Automatic bottle washing, sterilizing, and capping equipment is used to cut labor costs and eliminate problems associated with conventional rubber stoppers. (AEC)

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This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is indentifiable by the absence of a report number.

General Indexing Style

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ξ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
  Al–Cr ...
CHROMIUM ALLOYS
  Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly with cross references under the element components. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
  Si–W ...
TUNGSTEN SYSTEMS
  Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

In this subject index specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract than would be possible with only a word or two whenever it appears that such information would be useful. Such phrases are written so that the idea considered most important is presented first, should a not-too-awkward expression result. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium—allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

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437238	18-42110	See FGT-2622
439221	18-41710	See AL-TDR-64-46
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601012	18-42866	See ML-TDR-64-52
601048	18-42787	See ARL-64-43
601084	18-41678	See NOLTR-64-21
601316	18-43074	See AID-P-64-40
603016	18-42111	See NARF-63-18T
603342	18-42786	See AEDC-TDR-64-107
603364	18-42112	See RSIC-150(Vol.I)
603366	18-42113	See RSIC-150(Vol.I)(App.B)
603367	18-42114	See RSIC-150(Vol.I)(App.C)
603368	18-42115	See RSIC-150(Vol.I)(App.D)
603370	18-42116	See RSIC-150(Vol.I)(App.F)
603371	18-42117	See RSIC-150(Vol.I)(App.G)
603372	18-42119	See RSIC-150(Vol.I)(App.I)
603384	18-42118	See RSIC-150(Vol.I)(App.H)
604192	18-42868	See TO-B-64-1
604337	18-42017	See NRL-6095
604409	18-41916	$2.00(OTS)
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358	18-41611	Dep.(mn)
AERE-NP–	**(British)**	
GEN-38	18-42752	Phys. Rev. Letters, 13: 412-15(1964)
AERE-R–	**(British)**	
4405	18-42128	J. Nucl. Mater., 12: 145-52(1964)
4465	18-42129	J. Nucl. Mater., 12: 167-72(1964)
4472	18-41964	J. Electrochem. Soc., 111: 1133-6(1964)
4527	18-42314	Phys. Chem. Solids, 25: 1005-13(1964)
4553	18-42576	Dep.; $0.60(BIS), 3s. (HMSO)
4645	18-41309	Dep.; $0.60(BIS), 3s. (HMSO)
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3323:4	18-42153	
3780:1	18-42155	See ML-1190
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7582	18-41800	Nucl. Instr. Methods, 28: 260(1964)
7686	18-42131	J. Nucl. Mater., 12: 257-9(1964)
7764	18-41157	Proc. Natl. Acad. Sci. U. S., 52: 219-21 (1964)
7812	18-42580	Dep.(mn); $1.00(cy), 1(mn) OTS
7858	18-43101	Dep.(mn); $1.00(cy), 1(mn) OTS
8059	18-41395	Inorg. Chem., 3: 1412-16(1964)
8112	18-41858	Rev. Sci. Instr., 35: 1525-8(1964)
8169	18-42755	Phys. Rev. Letters, 13: 444-5(1964)
8272	18-42424	Phys. Letters, 12: 134-6(1964)
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1128	18-41603	EM
1131	18-41876	EM
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8	18-41307	See UCRL-9787(Rev.)
CONF-40–	**18-41951**	**(American Vacuum Society Vacuum Metallurgy Conference, 6th Annual Conference on Vacuum Metallurgy, New York, June 1963)**
CONF-174–	**18-41728**	**(12th Annual Conference Application of X-ray Analysis, Denver, Aug. 1963)**
4	18-41729	Advan. X-Ray Anal., 7: 265-80(1964)
CONF-315–	**(Norton Company's Symposium on the Technology of Powder Filled UO$_2$ Fuel Elements, Worchester, Mass., Nov. 1963)**	
3	18-42965	See EXP-NRX-20605
CONF-337–	**(International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963)**	
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24	18-41360	ORINS
25	18-41707	ORINS
26	18-41663	ORINS
27	18-41361	ORINS
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29	18-41879	ORINS
51	18-41949	ORINS
56	18-41950	ORINS
59	18-41708	ORINS
CONF-425–	**(Conference on Nonfissile Metals for Nuclear Reactors, Bologna, Dec. 1963)**	
3	18-41976	See EUR-1818-i
CONF-446–	**(American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964)**	
14	18-42874	ORINS. Gmelin, AED-CONF-64-081-5
25	18-42580	See BNL-7812
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35	18-42013	Dep.(mn); $2.00(cy), 1(mn) OTS; Gmelin, AED-CONF-64-081-3
CONF-452–	**(American Physical Society, Washington, D. C., Apr. 1964)**	
49	18-42783	ORINS. Gmelin, AED-CONF-64-044-68
50	18-42328	ORINS. Gmelin, AED-CONF-64-044-66
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1	18-41719	See SCL-DC-64-57
CONF-515–	**(2nd Annual National Electronics Packaging and Production Conference, New York, June 1964)**	
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CONF-534–	**(Biophysical Society 8th Annual Meeting, Chicago, Feb. 1964)**	
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45	18-42379	See UCRL-11446
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59	18-41759	See BNL-8327
61	18-42372	See JINR-P-1809

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65	18-42467	See JINR-E-1786
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71	18-42210	See JINR-E-1805
74	18-42469	See JINR-E-1794
76	18-42368	See JINR-E-1804
77	18-42366	See JINR-E-1802
78	18-41769	See JINR-E-1806
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81	18-42381	See UCRL-11547
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9	18-41758	See BNL-8309
CONF-570–	**(AEC Symposium on Advanced Converter Reactor Prototypes, Washington, D. C., Mar. 1964)**	
2	18-43024	See DPW-64-135
CONF-571–	**(American Chemical Society 148th National Meeting, Chicago, Aug.–Sept. 1964)**	
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11	18-41563	See ORNL-P-279
CONF-644–	**(7th National Heat Transfer Conference, Cleveland, Aug. 1964)**	
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11	18-42971	ORINS
16	18-41623	ORINS
18	18-41624	ORINS
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CONF-651–	**(9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.–Sept. 1964)**	
10	18-42551	See ORNL-P-421
CONF-654–	**(American Nuclear Society Meeting, San Francisco, Nov.–Dec. 1964)**	
2	18-41595	See LA-DC-6394
CONF-656–	**(9th Annual Minerals Symposium, Moab, Utah, May 1964)**	
2	18-41671	ORINS. Gmelin, AED-CONF-64-079-5
3	18-41606	ORINS. Gmelin, AED-CONF-64-079-6
CONF-671–	**(Data Processing Management Association Joint Computer Conference, Richland, Wash., Apr. 1964)**	
1	18-41907	See HW-SA-3465
CONF-674–	**(Joint Automatic Control Conference, Troy, N. J., June 1965)**	
1	18-41724	See WAPD-T-1708
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CONF-678–	**(4th World Congress on the Prevention of Occupational Accidents and Diseases, London, July 1964)**	
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CONF-681–	**(International Colloquium on Plasma Effects in Solids, Paris, July 1964)**	
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2	18-43113	See LADC-6181
3	18-43111	See LADC-6179
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1	18-42609	See TID-20165
CONF-687–	**(Meeting of the Latin-American Council for Cosmic Radiation and Space Physics, Tucuman and Buenos Aires, Argentina, Aug. 1964)**	
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1	18-41920	See COO-1198-204
CONF-692–	**(Symposium on Radiochemical Methods of Analysis, Salzburg, Austria, Oct. 1964)**	
1	18-41314	Dep.(mn); $1.00(cy), 1(mn) OTS
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1	18-43137	See UCRL-10981
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6	18-41753	ORINS
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1	18-41638	See ORNL-P-302
CONF-703–	**(10th Congress of the International Society of Blood Transfusion, Stockholm, Sept. 1964)**	
1	18-43116	See ORNL-P-274
CONF-704–	**(Proceedings of Fall Metallurgy, Paris, Oct. 1963)**	
1	18-41977	See EUR-1844.f
COO–		
1038-4	18-41073	$1.00(cy), 1(mn) OTS
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1198-170	18-41870	Rev. Sci. Instr., 35: 1611-12(1964)
1198-204	18-41920	Dep.(mn); $2.00(cy), 1(mn) OTS
1328-10	18-43138	See WIS-TCI-63G
1328-11	18-43139	See WIS-TCI-65G
CR–	**(Misc.)**	
15	18-43138	See WIS-TCI-63G
1860	18-42650	See TID-21144
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2-90224	18-43104	
DASA–	**(Misc.)**	
1308	18-41642	$1.25(OTS)
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DESY–	**(German)**	
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DP–		
823	18-41315	Dep.(mn); $1.00(cy), 1(mn) OTS
DPSPU–		
63-30-43	18-41984	Ind. Eng. Chem., Process Design Develop., 3: 309-13(1964)
63-30-44	18-41570	Ind. Eng. Chem., Process Design Develop., 3: 314-22(1964)
64-30-2	18-41643	Dep.(mn); $1.00(cy), 1(mn) OTS
DPW–		
64-135	18-43024	Dep.(mn); $4.00(cy), 2(mn) OTS
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
E–	**(Misc.)**	
2408	18-41938	For translation see EURAEC-1058
EANDC-US–	**(European-American Nuclear Data Committee)**	
54(L)	18-42650	See TID-21144
EIR–	**(Swiss)**	
47	18-41620	Neue Tech., 5: 714-24(1963)
66	18-41764	Dep.(mn)
EUR–	**(European Atomic Energy Community)**	
586.d(App.)	18-43058	Dep.(mc)
1805.e	18-42790	Dep.(mn)
1818-i	18-41976	Dep.(mn)
1844.f	18-41977	Dep.(mn)
1850.e	18-43105	Dep.(mn)
1887.f	18-43027	Dep.(mn)
EURAEC–		
884	18-41561	Dep.(mn); $2.00(cy), 1(mn) OTS
1034	18-42011	See ATL-A-141
1058	18-41938	Dep.(mn); $1.00(cy), 1(mn) OTS
1111(Pt.2)	18-41365	Dep.(mn); $2.00(cy), 1(mn) OTS
1128	18-41612	Dep.(mn); $1.00(cy), 1(mn) OTS
1129	18-41366	Dep.(mn); $1.00(cy), 1(mn) OTS
1168	18-42912	See ACNP-64585
1169	18-42913	See ACNP-64586
1180	18-42583	See GEAP-4547
EURO–	**(World Health Organization)**	
234	18-41698	Copenhagen, Regional Office for Europe World Health Organization, 1963. 72p.
EXP-NRX–	**(Canadian)**	
20605	18-42965	Dep.; $1.00(AECL)
FGT–	**(Non-AEC)**	
2622	18-42110	$3.60(OTS)
FTD-TT–	**(Non-AEC)**	
64-169	18-41776	OTS
64-892	18-43140	OTS
FZK–	**(Non-AEC)**	
9-194	18-42111	See NARF-63-18T
GA–	**(Misc.)**	
3398	18-41367	Dep.(mn); $2.00(cy), 1(mn) OTS
4449	18-41368	Dep.(mn); $1.00(cy), 1(mn) OTS
4807	18-42829	Phys. Fluids, 7: 1461-7(1964)
5072	18-42823	Phys. Fluids, 7: 1572-7(1964)

Report No.	Abstract No.	Availability
5581	18-42792	
GEAP–	**(Misc.)**	
4547	18-42583	Dep.(mn); $2.00(cy), 1(mn) OTS
4571	18-41613	Dep.(mn); $2.00(cy), 1(mn) OTS
4616	18-41614	Dep.(mn); $4.00(cy), 3(mn) OTS
4622	18-41615	Dep.(mn); $3.00(cy), 2(mn) OTS
4623	18-43028	Dep.(mn); $3.00(cy), 2(mn) OTS
GEMP–	**(Misc.)**	
37A	18-41921	Dep.; $3.00(cy), 3(mn) OTS
GEST–	**(Misc.)**	
2035	18-42348	Dep.(mn); $5.00(cy), 3(mn) OTS
HASL–		
149	18-41644	Dep.; $5.00(cy), 3(mn) OTS
HW–		
51762	18-41316	$2.00(cy), 1(mn) OTS
67944	18-43110	Dep.(mn); $3.00(cy), 2(mn) OTS
68600-42	18-41922	Dep.; $1.00(cy), 1(mn) OTS
71710(Rev.)	18-41765	Dep.(mn); $1.00(cy), 1(mn) OTS
80500	18-41010	Dep.; $6.00(cy), 5(mn) OTS
80991	18-41647	Dep.; $6.00(cy), 4(mn) OTS
81957	18-41626	Dep.; $3.00(cy), 2(mn) OTS
82254(Rev.)	18-41676	Dep.(mn); $1.00(cy), 1(mn) OTS
82436	18-41923	Dep.; $2.00(cy), 1(mn) OTS
HW-SA–		
3367	18-41019	See HW-80500(p.223-5)
3465	18-41907	Dep.(mn); $2.00(cy), 1(mn) OTS
HW-tr–		
79	18-41047	Dep.(mn); $1.60(fs), $0.80(mf) JCL
IA–	**(Non-AEC)**	
931	18-42735	Phys. Rev., 136: B370-73(1964)
969	18-42364	Dep.(mn)
IAE–	**(Russian)**	
562	18-42652	For translation see ANL-Trans-68
589	18-41711	Dep.(mn)
591	18-41712	Dep.(mn)
597	18-42584	Dep.(mn)
599	18-41766	Dep.(mn)
609	18-42631	Dep.(mn)
613	18-42632	Dep.(mn)
618	18-42329	Dep.(mn)
IDO–		
14633	18-43090	Dep.; $1.00(cy), 1(mn) OTS
28632	18-43029	Dep.; $3.00(cy), 2(mn) OTS
IEA–	**(Brazilian)**	
67	18-41767	Dep.(mn)
IFA-M–	**(Rumanian)**	
29	18-42209	Dep.(mn)
30	18-42633	Dep.(mn)
IITRI–	**(Misc.)**	
B241-8	18-41925	
578P19-13	18-41924	Dep.; $2.00(cy), 1(mn) OTS
INSJ–	**(Japanese)**	
77	18-41768	Dep.(mn)
IS–		
746	18-41431	J. Phys. Chem., 68: 1676-1706(1964)
747	18-41430	J. Phys. Chem., 68: 1654-76(1964)
811	18-42154	Dep.(mn); $1.00(cy), 1(mn) OTS
876	18-41369	Dep.; $2.00(cy), 1(mn) OTS
917	18-41370	Dep.; $2.00(cy), 1(mn) OTS
JINR–	**(Russian)**	
D-1735	18-42466	Dep.(mn)
E-1752	18-42253	Dep.(mn)
E-1786	18-42467	Dep.(mn)
E-1787	18-42468	Dep.(mn)
E-1790	18-42365	Dep.(mn)
E-1794	18-42469	Dep.(mn)

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E-1802	18-42366	Dep.(mn)
E-1803	18-42367	Dep.(mn)
E-1804	18-42368	Dep.(mn)
E-1805	18-42210	Dep.(mn)
E-1806	18-41769	Dep.(mn)
P-1689	18-41713	Dep.(mn)
P-1692	18-42369	Dep.(mn)
P-1695	18-41770	Dep.(mn)
P-1713	18-42634	Dep.(mn)
1714	18-42721	Phys. Letters, 12: 112-13(1964)
P-1719	18-42470	Dep.(mn)
P-1723	18-42370	Dep.(mn)
P-1724	18-42635	Dep.(mn)
P-1727	18-42636	Dep.(mn)
P-1736	18-42471	Dep.(mn)
P-1750	18-42371	Dep.(mn)
P-1762	18-42472	Dep.(mn)
P-1764	18-41771	Dep.(mn)
P-1809	18-42372	Dep.(mn)
JPL-TR–	**(Non-AEC)**	
32-632	18-42014	
JPRS–	**(Non-AEC)**	
26310	*18-43141*	*$2.00(OTS)*
26459	18-42166	$4.00(OTS)
K-DP–		
36	18-42920	Dep.(mn); $1.00(cy), 1(mn) OTS
46	18-42921	Dep.(mn); $1.00(cy), 1(mn) OTS
356	18-41301	Dep.(mn); $2.00(cy), 1(mn) OTS
KAPL–		
3013	18-42585	Dep.(mn); $3.00(cy), 2(mn) OTS
3018	18-41957	Dep.(mn); $2.00(cy), 1(mn) OTS
KEA–	**(German)**	
114	18-42586	Dep.(mc)
125	18-42947	J. Nucl. Energy, Pt. A & B, 18: 425-47 (1964)
KFK–	**(German)**	
215	18-41562	Dep.(mn)
KFK-tr–	**(German)**	
158	18-41379	Dep.(mn)
KFKI–	**(Hungarian)**	
5/1963	18-43079	Dep.(mn)
16/1963	18-42637	Dep.(mn)
20/1963	18-42638	Dep.(mn)
1467/f	18-42639	Dep.(mn)
1467/r	18-42640	Dep.(mn)
1491/A	18-41772	Dep.(mn)
1491/G	18-42641	Dep.(mn)
KR–	**(Norwegian)**	
71	18-42922	Dep.(mn); $2.00(cy), 1(mn) OTS
LA–		
3100	18-41714	Dep.; $3.00(cy), 2(mn) OTS
3115-MS	18-42881	Dep.; $3.00(cy), 2(mn) OTS
LA-DC–		
6031	18-42642	Dep.(mn); $1.00(cy), 1(mn) OTS
6032	18-41371	Dep.(mn); $2.00(cy), 1(mn) OTS
6394	18-41595	Dep.(mn); $1.00(cy), 1(mn) OTS
6573	18-41591	Dep.(mn); $2.00(cy), 1(mn) OTS
6602	18-41681	See TID-7700(p.47-9)
LADC–		
6179	18-43111	Dep.(mn); $1.00(cy), 1(mn) OTS
6180	18-43112	Dep.(mn); $1.00(cy), 1(mn) OTS
6181	18-43113	Dep.(mn); $1.00(cy), 1(mn) OTS
6221	18-42057	J. Nucl. Mater., 12: 226-36(1964)
6244	18-42308	J. Chem. Phys., 41: 2443-52(1964)
6294	18-41527	J. Chem. Phys., 41: 2435-42(1964)
6457	18-41429	J. Opt. Soc. Am., 54: 1283-4(1964)
6459	18-41855	Rev. Sci. Instr., 35: 1483-5(1964)
6466	18-42734	Phys. Rev., 136: B351-65(1964)
6486	18-41584	Rev. Sci. Instr., 35: 1534-5(1964)
LAMS–		
3099	18-42473	Dep.; $3.00(cy), 2(mn) OTS
LAS-L–		
T-5	18-41616	See TID-21151
M–	**(Misc.)**	
65-3-1	18-41978	See NP-14348
MAB–	**(Non-AEC)**	
201-M	18-41926	
MATT–		
218	18-42833	Phys. Fluids, 7: 1501-16(1964)
232	18-42817	J. Appl. Phys., 35: 3071-2(1964)
274	18-42474	Dep.(mn); $4.00(cy), 2(mn) OTS
MIT–	**(Misc.)**	
2098-49	18-42746	Phys. Rev., 136: B438-46(1964)
MITNE–	**(Misc.)**	
46	18-42923	Dep.; $4.00(cy), 3(mn) OTS
ML–	**(Misc.)**	
1190	18-42155	$5.00(fs), $1.00(mf) OTS
ML-TDR–	**(Non-AEC)**	
64-52	18-42866	$2.00(OTS)
64-169	18-41506	OTS
64-280	18-42020	See PB-171809(Rev.)
MLM–		
1199	18-41927	Dep.; $0.50(cy), 1(mn) OTS
MPI-PA–	**(Misc.)**	
7/64	18-42156	Dep.(mn)
MTP-AERO–	**(Non-AEC)**	
64-4	18-41677	$2.60(fs), $0.92(mf) OTS
MTP-RP–	**(Non-AEC)**	
64-1	18-42867	$7.60(fs), $2.54(mf) OTS
N–	**(Misc.)**	
64-17577	18-42373	See NASA-CR-53233
64-17579	18-42519	See *SUI-64-1*
64-17584	18-42801	See SEL-64-003
64-17610	18-41677	See MTP-AERO-64-4
64-17685	18-42867	See MTP-RP-64-1
64-25010	18-41928	See NASA-CR-54089
NAA-SR-Memo–		
9750	*18-43060*	*Dep.(mn); $1.00(cy), 1(mn) OTS*
9786	18-43061	Dep.(mn); $1.00(cy), 1(mn) OTS
9856	18-43030	Dep.(mn); $2.00(cy), 1(mn) OTS
NARF–	**(Non-AEC)**	
63-18T	18-42111	$2.00(OTS)
NASA-CR–	**(Misc.)**	
53169	18-42519	See SUI-64-1
53200	18-42801	See SEL-64-003
53233	18-42373	$2.60(fs), $0.95(mf) OTS
54089	18-41928	$12.50(OTS)
54111	18-43062	
NASA-TMX–	**(Non-AEC)**	
51312	18-42867	See MTP-RP-64-1
54700	18-41677	See MTP-AERO-64-4
NASA-TN–	**(Misc.)**	
D-1587	18-42882	$0.50(OTS)
D-2464	18-42015	$2.00(OTS)
NASA-TT–	**(Non-AEC)**	
F-240	18-42349	$0.50(OTS)
NOLTR–	**(Non-AEC)**	

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64-21	18-41678	$1.75(OTS)
NORA–	**(Norwegian)**	
9	18-42922	See KR-71
NP–	**(AEC File No. for Non-AEC Reports)**	
14200	18-41893	Dep.(mn)
14206	18-42643	Dep.(mn)
14221	18-41929	Dep.(mn)
14228	18-42157	Dep.(mn)
14236	18-43114	
14243	18-42374	Dep.(mn)
14254	18-41648	
14281	18-42158	
14290(Pt.B)	18-43031	Dep.(mn); $7.00(cy), 6(mn) OTS
14294	18-41930	
14319	18-43032	Dep.(mn); $7.96(cy), 8(mn) OTS
14326	18-42475	Dep.(mn)
14327	18-41045	Dep.(mn)
14329	18-42644	Dep.(mn)
14333	18-41046	Dep.(mn)
14338	18-42645	Dep.(mn)
14344	18-41596	Dep.(mn)
14348	18-41978	
14349	18-42587	Dep.(mn)
14432	18-42433	Phys. Letters, 12: 155-6(1964)
NRL–	**(Misc.)**	
6095	18-42017	Dep.(mn); $1.00(cy), 1(mn) OTS
6128	18-42018	$3.00(OTS)
NYO–		
841-1	18-41679	Dep.(mn); $3.00(cy), 2(mn) OTS
1807-5	18-42744	Phys. Rev., 136: B420-5(1964)
2038-1	18-43115	Dep.(mn); $3.00(cy), 2(mn) OTS
2679	18-42883	Dep.(mn); $4.00(cy), 2(mn) OTS
3194-1	18-42884	Dep.; $5.00(cy), 3(mn) OTS
3246-1	18-41773	Dep.(mn); $3.00(cy), 2(mn) OTS
3246-2	18-41774	Dep.(mn); $2.00(cy), 1(mn) OTS
3319-3	18-41089	Dep.(mn); $1.00(cy), 1(mn) OTS
4700(Rev.) (Suppl.1)	18-41317	Dep.; $7.00(OTS)
10212	18-42923	See MITNE-46
ORNL–		
3675	18-41507	Dep.; $1.00(cy), 1(mn) OTS
3678	18-42019	Dep.(mn); $4.00(cy), 2(mn) OTS
3687	18-41717	Dep.; $2.00(cy), 1(mn) OTS
ORNL-P–		
193	18-42298	Dep.(mn); $1.00(cy), 1(mn) OTS
194	18-42726	Phys. Letters, 12: 121-3(1964)
227	18-41718	Dep.(mn); $2.00(cy), 1(mn) OTS
274	18-43116	Dep.(mn); $1.00(cy), 1(mn) OTS
278	18-42793	Dep.(mn); $1.00(cy), 1(mn) OTS
279	18-41563	Dep.(mn); $1.00(cy), 1(mn) OTS
281	18-41372	Dep.(mn); $1.00(cy), 1(mn) OTS
295	18-42160	Dep.(mn); $1.00(cy), 1(mn) OTS
297	18-42161	Dep.(mn); $1.00(cy), 1(mn) OTS
302	18-41638	Dep.(mn); $1.00(cy), 1(mn) OTS
310	18-41908	Dep.(mn); $3.00(cy), 2(mn) OTS
421	18-42551	Dep.(mn); $1.00(cy), 1(mn) OTS
ORNL-TM–		
642	18-41303	Dep.(mn); $3.00(cy), 2(mn) OTS
689(Rev.)	18-43080	Dep.(mn); $1.00(cy), 1(mn) OTS
716	18-43063	Dep.(mn); $2.00(cy), 1(mn) OTS
759	18-43081	Dep.(mn); $1.00(cy), 1(mn) OTS
775	18-41304	Dep.(mn); $2.00(cy), 1(mn) OTS
776	18-41305	Dep.(mn); $2.00(cy), 2(mn) OTS
782	18-41508	Dep.(mn); $1.00(cy), 1(mn) OTS
830	18-43091	Dep.(mc); $10.10(fs), $4.07(mf) OTS
929	18-41979	Dep.(mn); $1.00(cy), 1(mn) OTS
935	18-43082	Dep.(mn); $2.00(cy), 1(mn) OTS
943	18-41775	Dep.(mn); $1.00(cy), 1(mn) OTS
954	18-42646	Dep.(mn); $1.00(cy), 1(mn) OTS
957	18-42588	Dep.(mn); $1.00(cy), 1(mn) OTS
ORNL-tr–		
175	18-41567	Dep.(mn); $1.60(fs), $0.80(mf) JCL
224	18-41511	Dep.(mn); $1.00(cy), 1(mn) OTS; $1.10(fs), $0.80(mf) JCL
226	18-41512	Dep.(mn); $1.00(cy), 1(mn) OTS; $1.60(fs), $0.80(mf) JCL
259	18-41308	Dep.(mn); $1.00(cy), 1(mn) OTS; $1.10(fs), $0.80(mf) JCL
270	18-41683	Dep.(mn); $2.60(fs), $1.10(mf) JCL
296	18-42026	Dep.(mn); $1.60(fs), $0.80(mf) JCL
PAN–	**(Polish)**	
496/XIV	18-41980	Dep.
503/IX-A	18-42589	Dep.
505/IX-A	18-43033	Dep.
508/VII	18-42647	Dep.
522/VIII	18-41318	Dep.(mn)
523/XVII	18-41496	Dep.
528/IX	18-42966	Dep.
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
969.662	18-42892	
969.685	18-42893	
969.814	18-43072	
969.831	18-42862	
969.861	18-41880	
969.862	18-41881	
969.870	18-42863	
969.889	18-42972	
969.897	18-41607	
969.899	18-41608	
969.917	18-41754	
969.963	18-42886	
969.975	18-41988	
969.984	18-42894	
970.074	18-41593	
970,091	18-42864	
970,094	18-41953	
970.118	18-43053	
970.164	18-41609	
PATENTS	**(French)**	
76,456	18-42973	See French Patent 1,200,408(Add.1)
77,447	18-42979	See French Patent 1,241,855(Add.1)
77,484	18-42977	See French Patent 1,238,281(Add.2)
78,150	18-42980	See French Patent 1,241,855(Add.2)
79,227	18-42981	See French Patent 1,241,855(Add.3)
80,212	18-42986	See French Patent 1,273,896(Add.1)
1,174,795	18-41981	For translation see AEC-tr-6478
1,200,408(Add.1)	18-42973	
1,207,197	18-42101	
1,208,777	18-42954	
1,212,052	18-41478	
1,217,058	18-42102	
1,219,325	18-42974	
1,221,443	18-41479	
1,223,824	18-42975	
1,224,231	18-41989	
1,229,765	18-41968	
1,232,111	18-42976	
1,233,911	18-41990	
1,238,281(Add.2)	18-42977	
1,241,855	18-42978	
1,241,855(Add.1)	18-42979	
1,241,855(Add.2)	18-42980	
1,241,855(Add.3)	18-42981	
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1,251,523	18-41481	
1,253,399	18-42982	
1,260,085	18-41482	
1,264,536	18-42875	
1,267,602	18-42983	
1,267,989	18-41991	
1,272,050	18-42984	
1,273,896	18-42985	
1,273,896(Add.1)	18-42986	
1,274,370	18-42987	
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1,278,417	18-43055	

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1,278,442	18-41500	
1,278,443	18-41501	
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1,278,445	18-41503	
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1,289,111	18-42988	
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1,289,662	18-41994	
1,290,178	18-41995	
1,290,243	18-41484	
1,290,403	18-41485	
1,290,492	18-41996	
1,290,718	18-42990	
1,291,805	18-41997	
1,293,406	18-41998	
1,294,074	18-42991	
1,295,817	18-41486	
1,295,976	18-42992	
1,296,941	18-42993	
1,297,636	18-41362	
1,298,010	18-42994	
1,298,452	18-41999	
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1,303,026	18-42996	
1,303,032	18-41487	
1,303,033	18-41488	
1,303,034	18-42104	
1,303,045	18-42001	
1,303,064	18-42997	
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1,303,828	18-42999	
1,307,236	18-41971	
1,307,550	18-41972	
1,308,213	18-43089	
1,308,382	18-41489	
1,308,519	18-43000	
1,308,523	18-43073	
1,309,533	18-41973	
1,309,580	18-41490	
1,309,581	18-41491	
1,311,438	18-41505	
1,311,516	18-41492	
1,312,302	18-43001	
1,316,161	18-43002	
1,316,822	18-43003	
1,316,823	18-43004	
1,317,848	18-42004	
1,317,878	18-43005	
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1,318,083	18-43006	
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1,321,606	18-43008	
1,321,607	18-43009	
1,321,767	18-43056	
1,321,771	18-42006	
1,322,494	18-42007	
1,322,595	18-42106	
1,322,729	18-43010	
1,323,725	18-43011	
1,323,900	18-42008	
1,324,796	18-43012	
1,325,329	18-42009	
1,327,572	18-42896	
1,329,632	18-43013	
1,330,152	18-41904	
1,330,406	18-43014	
1,330,822	18-42897	
1,330,823	18-42898	
1,330,824	18-42899	
1,331,406	18-43015	
1,331,473	18-43016	
1,332,091	18-42900	
1,332,393	18-43017	
1,333,933	18-42901	
1,333,954	18-42955	
1,334,817	18-43018	
1,335,189	18-41494	
1,336,233	18-43019	
1,336,826	18-42902	
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